The end of global net oil exports

What really matters in the Peak Oil debate

by

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Dedicated to Jeffrey J. Brown, the pioneer of global net oil export mathematics.

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Preface

I have, through calculations on my blogs “Forest Man” (www.larslars.blogg.se) and “I väntan på Jesus” (www.skog-slars.blogg.se), which are forming the chapters of this book, arrived to the conclusion that sometime during the year 2026 or even as late as 2027, **not a few store shelves in Sweden might begin to be empty because of the lack of diesel in the world**. Sweden may be without diesel to import as early as during 2025-2026, or 2027 at the latest, according to my numerous calculations. In 2027 the world has only an estimated 380 000 barrels of diesel exports to share, which China and India very quickly will consume, while the world had over 6,4 million barrels of diesel exports to share in 2005, when oil exports and diesel exports peaked. 380 000 barrels is only about 6% of what we had 2005, or about 1/17. I.e. the world economy will shrink drastically because of that, many of the at least 85 oil import countries (see here, a site with very old and incomplete data, however, according to Jeffrey J. Brown in the article "Commentary: The export capacity index" on Resilience.org, February 18, 2013 [see the Summary], there were 155 net oil importing countries **already in 2005, a figure that is constantly growing**) will maybe shrink by a quarter or a half in their GDP in 2026-2027, relative to now. Because our economies build upon the promise of eternal growth, this shrinkage will lead to their collapse, and many store shelves will soon be empty. This means that I might begin to starve already during the winter 2025-2026, and die around 2030 from starvation, at the latest, instead of in January 2036, as I believed before, if I for some reason cannot pay for partaking in farming in the countryside, or survive in some underground bunker.

I build my calculations largely on the work of professional, licensed oil geologist Jeffrey J. Brown, the pioneer of oil export math, and especially on his estimate that we in 2021 had 30

million barrels of oil per day (mbd) left (see the article "The Road To Clean Energy Is Messier Than We Thought" from 14.10.2021). The problem is that he does not specify if this volume is “All Liquids” (all the liquids that are ever counted as “oil”) or crude + condensate only or conventional oil only. I have supposed that he meant All Liquids, and calculated based on that, but even if he meant crude + condensate or only conventional oil, it does not buy us much time (this failure, not to specify what kind of oil we talk about, is a big problem in Peak Oil literature, Peak Oil discussions and Peak Oil math).

Why does it not buy us much time? Because the real issue here is the **rate of decline**, how fast the volume of oil exports declines, not how much oil exports we have from the beginning. If it declines by 5 %, it will reach zero pretty much at the same time if the volume of oil we have is 30 or 35 million barrels per day (mbd). If it buys us time, it is only a question of months, not years. This is fundamental to understanding this book.

This fact pertains also to the fact that Brown’s numbers may be too radical, that we have more oil exports to begin with, than Brown says. This might buy us only months, not years.

So the thesis of this book stands or falls with the correctness of the decline rate that Brown gives us. Therefore I have calculated with several different parameters as regards the decline rate, and all point in the same direction. The difference between them is a few years at most. Therefore I assume that my thesis is solid, which is that the end of global net oil exports in 2030-2032 (Brown’s scenario) is a best-case scenario.

Collapse can, I think, begin in earnest already in 2026, only because of **too little** diesel exports. Observe that oil exports vanish successively, more and more, not all at once.

If my calculations in part 2 are correct, **we lose 5,3 mbd of**

overall oil exports (not only diesel) this year and 6,8 mbd next year. This is almost 500 000 mbd every month. It is really difficult to believe (but I have to follow my calculations, wherever they lead).

It's important to remember that global oil exports has had a steep accelerated rate of decline **even when global oil production (both conventional and unconventional) was growing.** Therefore the decline will be really steep when global oil production plateaus, **let alone begins to exponentially decline**, then we will go over the "**Energy Cliff**", and the Great Collapse is here.

I have done many different calculations, from different angles and with different parameters, to try to validate my results, and all calculations confirm my results above, more or less, all point in the same direction. I have counted them, and **it is eleven different sets of calculations, all pointing in the same direction. Regarding the end of "ANE" ("available net exports") one say it will happen 2023, four say 2024, seven say 2025, six say 2026, four say 2027, and one say around 2030 (my starting point in the beginning of the book).** "ANE" means global net oil exports minus the combined net oil imports of China and India.

I have serious trouble believing in my own calculations. They feel too radical. Maybe there is something wrong with the data or with my calculations. Therefore I think 2027 is the most likely time for the end of "ANE" globally. This is also what the blogger "Crash Watcher" ended up with (he has done very detailed research), when he calculated the end of the net oil exports of the ten biggest oil exporting countries, which is really what counts here.

It is almost not possible to really believe that global oil exports are declining exponentially right now (i.e. at an accelerated rate of decline, which means that the decline goes faster and faster),

as I have shown in this book (because almost no one talks about it, we do not want it to be true). This means that the collapse of civilization will also be exponential, going faster and faster. **It means that it is exponential <u>right now</u>.** Who can really fathom this fact? We have to be really deep into collapse news to be able to feel the realism of this. And I am. But I have still problems believing it, because I don't see it happening in Stockholm, where I live. It happens elsewhere, though, to some degree.

This is not reflected on the site www.oilprice.com, the most important website of the global oil industry. It is never mentioned. Even [Peak Oil]() is seldom mentioned there. **Almost only** when [Gail Tverberg]() is allowed to post the blogposts from her own blog there, which happens about once a month, the reality of Peak Oil is coming through. I follow this site regularly.

This is really bad for our adaptation to a post carbon future, which has to come, it is a mathematical certainty. It is also a mathematical certainty that the collapse will be exponential.

Lars Larsen, Stockholm 25.5.2023 (the twelfth edition updated 22.3.2024)

P.S. I use the phrase "exponential decline" in this book to mean about the same as "an accelerated rate of decline", which means that the decline goes faster and faster with time. I know that in mathematics overall, this is not usual, but some peakoilers do it, therefore I do it.

SECTION 1: The material in the original edition

A simple explanation of oil geologist Jeffrey J. Brown's "Export Land Model"

Licensed professional oil geologist Jeffrey J. Brown is one of the world's most famous oil geologists. He has developed a tool to calculate the amount of oil exports that the world and individual countries can sell on the world oil market. The tool is called "Export Land Model". It is actually a very simple mathematical tool, easy to understand. But almost no politicians care to talk about it, which is fatal, because the amount of available oil exports is really even more important than the timing of Peak Oil, and more acute than climate change. Energy expert Kurt Cobb explains the tool excellently, in a few sentences, in the article "Importing Nations Feel the Squeeze as Global Oil Exports Steady Decline" on OilPrice.com, 9/24/2012:

"As Brown began to think about the export issue back in 2006, he made two observations which seem obvious once you hear them: First, if the economy of an oil-exporting country grows, that country typically will use more oil to support that growth. Second, once total production peaks and starts to decline in an oil-exporting country, exports almost always decline much faster than total production. This is because exports are typically being squeezed from two sides. Production is falling making less oil available for exports, and consumption is rising with the same effect. (Declining net exports can also occur if domestic consumption is rising faster than production which is what happened in the United States, causing the country to become a net importer for the first time way back in 1948.)"

All countries should ration their remaining oil, and plan for the end of the oil age.

Jeffrey J. Brown was the one who brought the issue of oil exports to the focus of many peakoilers and collapsologists ten, fifteen years ago. If you google for recent texts by him or interviews with him, you don't find much, the latest by him or about him is **only one** article on “Forbes” in October 2021,"The Road To Clean Energy Is Messier Than We Thought", by Loren Steffy, UH Energy Scholar (not easy to find if you google for it), and after that you find on google some comments on “www.oilprice.com” from the beginning of 2018, and one interview from 2017 at the Peak Prosperity blog, see here. After 2021 there is basically a deafening silence around him and from him. Why? Shouldn't he become more and more famous the closer we get to the end of the oil export market? Shouldn't all countries calculate oil exports and imports, so we can plan for the end of the oil age? So we could degrow in a controlled way, collapse in a controlled way, not in a chaotic way? This silence and uninterest is for me incredible, unfathomable stupidity. I can't almost believe it's true, so strange it is.

The same one could say about the whole issue of calculating oil exports according to the Export Land Model, it has just vanished from the scene, you don't find anything about it since 2017.

In fact, rationing the remaining oil, yes all the remaining fossil energy, is maybe the single most important thing to do in the whole world right now. And Peak Oil is the single most important event in modern time, or, maybe Peak Oil Exports (which happened in 2005, google "peak oil exports happened in 2005" and you only find one article about it, or, it is not even an article, it is a comment to an article. I wrote this in the end of 2022) is even more important, but it is linked to Peak Oil,

which also happened at the same time, if you only count conventional oil.

We are walking blind and deaf over the “Energy Cliff”. Not even the current energy crisis and the record high energy prices are able to get us to explore oil exports according to the Export Land Model on the internet.

It would have been nice to know how much time we have left to live as a civilization, yes, even more individually. This can be best known by calculating the remaining volume of oil exports, if our country doesn’t produce any oil itself, and if we produce oil ourselves, by calculating our remaining oil reserves and the volume of probable future oil discoveries.

If you are a dying cancer patient, you would like your physician to estimate how long you have left to live, so you can plan accordingly. In fact it is the duty of every physician to try to figure this out and tell the results to the patient.

And yet we usually do not calculate the time civilization and we ourselves have left. Shouldn't we be interested in knowing this?

But I have calculated anyway, based on the little information there is out there on the internet. It is usually very old information (mostly ten years old and older), but it is possible to make a rough estimate of when civilization will collapse and oneself will starve to death. And my estimate is that around 2027-2032 at the latest (I have written about this before, in Swedish, here), when the oil export market will vanish completely, save for China and India, civilization will collapse from the fact that most countries will be without oil to import, **because only 33 countries stand for 99 % of the oil export volume (this was in 2012)**. So about 162 countries will be without oil to import *, and they will drag the oil exporting

countries with them down into the collapse. I build this estimate on the Export Land Model.

I have five years of playroom, because I build on so old data. If I had newer data about the present volume of oil exports, I could calculate more exactly the time of the collapse of civilization.

* even if only half of the countries in the world, i.e. 97 countries, would be without oil to import, civilization would still collapse. We are so interdependent nowadays. You should also notice that the volume of oil to import is gradually decreasing, and doesn’t go from normal volume to zero at once. A country could collapse even when half of the oil imports needed is gone. But I calculate very conservatively, with a best-case scenario in mind.

Global Net Oil Export mathematics, part 1: How I calculate the end of the oil export market

I have seriously and carefully tried to find information online about how much oil exports is left on the market in 2022 (I wrote this in the end of 2022), but I found nothing. This is very significant. One is silent about the most important thing. Oh well, I finally found a few articles. The closest I come is the article "The Road To Clean Energy Is Messier Than We Thought", by Loren Steffy, UH Energy Scholar, 14.10.2021 on Forbes, where it is said that:

"(Jeffrey) Brown has tracked the combined net exports of the world's 33 oil exporting nations since 2005. That year, global net exports peaked at 45 million to 46 million barrels a day, and they haven't exceeded that level since. Instead, the amount of oil available for export worldwide has steadily declined. He estimates it has fallen to about 30 million barrels a day."

My comment: Going from 45-46 million barrels to 30 million barrels from 2005 to 2021, that's a decline of 15-16 million barrels, i.e. approximately a 30% decline, in about sixteen years. And I calculate the decline in percentage per year to be approximately 1.9%, i.e. approximately 1 million barrels per year (1 is 1,9 % of 45). Note that this is only the average decline, **as the decline accelerates over time** * (check out the Export Land Model to study this deeper). But if we project the rate of decline so far into the future, and do not expect the rate of decline to accelerate, or if we roughly estimate that we lose 1 million barrels per year in oil export volume in the world, from now on into the future, then, counting from 2021, we have only 21 million barrels of oil exports to share in 2030, and 15 million barrels of oil exports to share in 2036, the year I guess I'll die of starvation. If we count on an acceleration of the decline rate, we may have only 5 million barrels of oil exports

on the market in 2036, an amount that would soon be swallowed up by China and India alone. If we expect that China and India will together increase their GDP by what is for them a modest 5% per year (1) after 2021, year by year, and thus increase their oil consumption by about the same figure per year, then India's oil consumption, which is about 5 mbd (million barrels per day) today, will increase (roughly calculated in the head, 5 % of 5 mbd is 0,25 mbd, 15 x 0,25 is 3,75, and then I add a little more, accounting for the exponential function in this exponential rise) in fifteen years by almost five mbd, which means it will rise to almost nine, ten mbd, and then China's oil consumption, which is about 15,5 mbd today, increases in fifteen years by thirteen to fifteen mbd (5 % of 15,5 mbd is 0,775, 15 x 0.775 is 11,625 and then I add a little more, accounting for the exponential function in this exponential rise) to a total of close to twenty-eight, twenty-nine, thirty mbd in 2036. In total, then, these two countries increase their oil consumption by **at least eighteen mbd by 2036**, a rate of increase **that would quickly eat up whatever remains of the oil export market <u>as early as around 2030</u>, or even sooner** (2). Note that Jeffrey J. Brown has come to similar conclusions.

This is simple mathematics. You were able to follow me, weren't you? Our days are numbered. It does not take a rocket scientist to figure this out. And this is yet a best case scenario. Because I have not taken into account the following "**ten critical factors**", each weighing a lot:

1) Possible wars that will disrupt the oil industry (think an escalation of the Ukraine war, a possible Third World War, not to mention a nuclear war between Russia and USA).

2) Natural disasters of all kinds, things like super solar storms, supervolcanoes, floods, droughts, wildfires and hurricanes which will disrupt the oil industry (especially the offshore oil industry and coastline refineries).

3) The possibility of **our oil reserves being overstated by half** (note that Jeffrey Brown's calculations are based on **BP Statistical Review data**, which is the official data, the very optimistic corporation and government data), see Ron Patterson's article about it here.

4) The bursting of the US shale oil bubble and the fall of the Shale Oil Ponzi Scheme which leads to a very steep decline of the US shale oil production.

5) The very steep decline rate in the future of conventional oil production due to a long time of all kinds of Enhanced Oil Recovery (things like pumping water into the oil wells).

6) The collapse of future oil discovery because of lack of upstream capital investment, due to the bursting of the Everything Bubble, oil scarcity and climate concerns (Green transition efforts).

7) The possibility of civilization collapsing around 2025-2030 because of a combination of energy shortages and abrupt climate change, which will lead to the collapse and demise of the oil industry because everything is linked. See a video about it here.

8) The issue of the lack of affordability in the oil industry and in the world. According to academic peakoiler Gail Tverberg most of the oil reserves will be left in the ground in the future because it will be uneconomical to exploit, and because of too high EROEI (Energy Returned on Energy Invested). "*A large share of the world's oil reserves are unconventional oil reserves, of one type or another. The fact that rising oil prices are a real problem for citizens means that these unconventional reserves are unlikely to be tapped. Instead, we may be*

dealing with seriously short supplies of products we need for operating our economies, including diesel oil and jet fuel."

*(*from the blogpost *"*Today's Energy Crisis Is Very Different from the Energy Crisis of 2005", posted on November 17, 2022 by Gail Tverberg on the blog "Our Finite World")

9) The wish for **energy conservation** in countries that wake up to the reality of Peak Oil, **keeping oil in the ground for future generations.**

10) Fungible sharing of the remaining exportable oil between the ex-exporting countries. This means that when an exporting country becomes an importing country, it begins to eat from the remaining volume of export oil of the remaining exporting countries, making it shrink very fast, by an accelerated decline rate.

...and so on.

* a much greater acceleration of the decline rate will come from the following fact: the conventional oil production plateaued between 2005 and 2016, and the volume of All Liquids rose during the same period, and in **spite of this** the volume of oil exports in the world has declined by 1 mbd per year on average from 2005 to 2021. Because of this the volume of oil exports will decline **much faster** when conventional oil production begins to decline (this decline has already begun!), not to speak of when All Liquids begins to decline, which makes it misleading to project the decline rate of the volume of export oil 2005-2021 upon the future**. If the decline was already a steep accelerated rate of decline during the time 2005-2021, when oil production was rising, how fast will it not be when All Liquids begin to decline, and it can begin to decline really fast, because of 4) and 5) above.**

(1) India's GDP grew by 8,3 % in 2021 (here is a chart of the history of GDP growth in India), and by 8,7 % in 2022 and China's GDP grew by 8,1 % in 2021 (it grew by 6,0 in 2019, here is a chart of the history of GDP growth in China) and by 4,4 % in 2022.

(2) observe that China imported around 10 million barrels of oil per day in 2021, and India imported around 4 million barrels per day during the same year, which together makes 14 million barrels per day of oil import. Add to this figure the 18 million barrels per day of increase in oil consumption and thus oil imports between 2021 and 2036, and you have 32 million barrels per day of oil imports only in China and India, which is more than there was on the oil export market in 2021. This was why I said that China and India **"would quickly eat up what remains of the oil export market as early as around 2030, or even sooner",** which means that there will not be any oil exports left to other countries than China and India at around 2030, which was also the conclusion that Jeffrey J. Brown came to in his calculations, referred to above. But this may be a best-case scenario, which I will explain later on, when I do more exact calculations. This is only a broad introduction, to give you a sense of where the Peak Oil community stood before this book, what "peakoilers" in general believed would happen.

Observe also that the rest of the world is also growing their oil consumption and their GDP, World GDP growth rate for 2021 was 6,1%, in 2022 it was 3,4 %, which eats more and more of the volume of oil exports available to the world.

Note also that according to Steve St. Angelo at the blog "SrsRocco Report", in this youtubevideo, world oil production today declines with 10 % a year, if no new oil is added, and

have to be replaced by **a Russia** in oil every year. This is possible now, but it can only continue for so long. Note also that oil exports decline at a far faster rate than the decline in oil production alone (see the Wikipedia-article "Export Land Model"). This is why my calculations above are a best case scenario. So what happens when we cannot offset the declines every year with new Russias? What happens to oil export decline when world oil production declines 10 % a year, which it will do at some point in time?

Global Net Oil Export mathematics, part 2: The end of the global net oil export market in 2030 is in fact a best case scenario

1) According to Dallas independent oil geologist Jeffrey J. Brown in the YouTube video interview from 2015 by Chris Martenson "Jeffrey Brown: To Understand The Oil Story, You Need To Understand Exports", there was a decline in global net oil exports of 3 million barrels per day (mbd) between 2005 and 2013 (from 46 to 43 mbd). 3 mbd in eight years. It is on average 0,4 mbd per year. Let's assume that the yearly decline is 0,3 mbd per year in the beginning of this period, and 0,5 mbd in the end of it.

2) There was (according to Brown in the article "The Road To Clean Energy Is Messier Than We Thought" from 14.10.2021) a decline in global net oil exports of 13 mbd between 2013 and 2021, from 43 to 30 mbd. 13 mbd in eight years. It is on average 1,6 mbd per year. It is four times, i.e. a whopping **quadrupling** of the decline rate of net oil exports in 1). Let's assume that the yearly decline is 0,6 mbd per year in the beginning of this period, and 2,6 mbd per year in the end of it.

3) Brown projects (in the YouTube interview 2015 above) a decline in global net oil exports of 30 mbd between 2021 and 2032, down to zero net oil exports (30 mbd is what we had in 2021) in 2032. 30 mbd in 11 years. It is 2,7 mbd per year. Note**: Not in line with the "accelerated decline rate" trend of the previous two paragraphs.** This isn't even a doubling of the decline rate of 2). It should be a quadrupling, i.e. four times the decline rate of 2).

4) If one tries to quadruple (in line with the trend in 1) and 2)) the average decline rate per year between 2013 and 2021, i.e.

quadruple 1,6 mbd per year, then one gets a decline rate of on average 6,4 mbd per year for the period 2021 to 2032, and then one doesn’t even reach 2032, **but the volume of net oil exports goes down to zero already <u>in 4,5 years</u>, i.e. already in May 2026 at the earliest, if we assume that we had 30 mbd in the end of 2021.** In this scenario the yearly decline could be 2,6 mbd per year in the beginning of the period, and 10,2 mbd per year in the end of it, which ends in 2026. Then we can construct the following model of how much oil exports we have each year:

2021: 30 mbd

2022: 30 mbd - 3,9 mbd = 26,1 mbd

2023: 26,1 mbd - 5,3 mbs = 20, 8 mbd

2024: 20,8 mbd - 6,8 mbd = 14 mbd

2025: 14 mbd - 8,4 mbd = 5,6 mbd

2026: 5,6 mbd - 10,2 = 0

Now, at last the decline goes so fast **that 30 mbd of global net oil exports vanishes in 4,5 years**, if we shall project out on the future the pace of the rate of acceleration that the decline had 2005-2021. **That all net oil exports vanishes for all countries in 2032, as Brown stated in the YouTube video interview above, is thus a best-case scenario**. This scenario above, the "2026-scenario", does not even take into account the end of "available net exports", "ANE", which is global net oil exports minus China and India's combined net oil imports, and if we take that into account, then we might land at 2025 as the end of global net oil exports, and, at worst, at 2024. But this last date feels too radical.

The "2026-scenario" neither takes into account my "ten critical factors" in part 1 of this book, factors which could make the decline even steeper.

In the rest of this book, I will try to see if I can validate and confirm the calculations above, to see if they are valid, by other calculations. I will especially focus on the remaining diesel exports.

Conclusion: The situation for Sweden

It may therefore very well happen that Sweden (where I live) loses its last oil to import already in 2026, and that I might die of starvation already around 2028-2030, as a best case scenario. It is also possible that the collapse of Sweden begins already 2025, when we get **too little oil to import** (observe, this is very important: **the volume of oil to import will steadily decline with time, not stop all at once**), and that the collapse is total already in 2028, not in 2030 as I have said before on my blog “Forest Man”.

We import most of our oil in Sweden from Norway, according to the graph on the website "Drivkraft Sverige", therefore Sweden should watch out very carefully for the future of Norwegian oil production. According to Jeffrey J. Brown in the YouTube video from 2013: "Jeffrey Brown - The Exporters' Dilemma: Rising Domestic Consumption and Flat or Falling Production", Norway loses its last oil exports in 2025, "*in a timeframe from about 2022 to 2028*" (in this YouTube video from 2008, 48:45 into the video and further, Brown says that Norway loses its last oil exports "in a 2024 timeframe"). So Sweden has, according to Brown in 2013, only about two years left (I write this 2023) of oil imports from Norway, at worst, five years at best. The difficulty to find new sellers of oil to buy from, may really screw up the Swedish economy.

Global Net Oil Export mathematics, part 3: Adding EROEI-calculations to our model.

According to Jeffrey J. Brown and Dr. Samuel Foucher, in the article "Declining net oil exports–a temporary decline or a long term trend?" (on “Resilience.org” on September 24, 2007), the volume of global net oil exports is, post global Peak Oil (which many think happened for All Liquids [this means all liquids that are counted as “oil” in petroleum statistics] in November 2018), **squeezed from two directions at the same time, from two exponential functions**, from:

1) Exponentially rising consumption. World energy consumption, and especially oil consumption, has in fact been rising exponentially until now, see the article "World Energy Consumption Since 1820 in Charts", posted on March 12, 2012 on the blog “Our Finite World” by Gail Tverberg.

2) Exponentially falling production. World oil production has fallen since 2018, and will continue to fall exponentially, see the article Peak Oil is Here! World oil production peaked in 2018, posted on February 1, 2022 by Alice Friedemann, on the blog “Energy Skeptic”. Still the decline is very small, as in the beginning of all exponential curves.

According to the blog “Crash Watcher” in the blogpost An Export Land Model Analysis for the USA-Part 4, the volume of global net oil exports **is also squeezed from a third exponential function**, namely:

3) Exponentially falling EROEI (Energy Returned on Energy Invested). It is a fact that the EROEI has fallen exponentially until now, and it will continue to do so, in an accelerated rate of decline. See the article "Energy Return on Investment (EROI) for U.S. Oil and Gas Discovery and Production" by

Matt Simmons on “Peak Oil News & Message boards”, January 25, 2013. A somewhat newer article about the same thing is Kurt Cobb's "The hidden reasons behind slow economic growth: Declining EROI, constrained net energy" on “Resilience.org” on April 5, 2015. This is also in full accordance with Peak Oil guru Richard Heinberg's statement **already in 2014** that "*costs of oil exploration/production is rising 10,9 % per year*" (*Douglas-Westwood)* (quoted from his 2014 lecture recorded on YouTube titled "Richard Heinberg on Snake Oil: How Fracking's False Promise of Plenty Imperils Our Future". See also this article). Because of exponentially falling EROEI, this cost is rising even faster today, I suppose (especially since all things cost more today, because of inflation). These rising costs are a function of the exponentially falling EROEI. Here you have the reason why the US shale oil industry is a Ponzi Scheme, a completely debt-fuelled and investment money-fueled operation, without real profits, but with big losses instead.

When the blogger “Crash Watcher” did this third exponential squeeze upon his data, squeezing it with three exponential functions, **it resulted in the volume of global net oil exports falling to zero well before 2030**. I quote his blogpost above:

"For instance, an ERoEI assumed to decline linearly from 20:1 to 2:1 from 2010 to 2030 would drive net exports to zero well before 2030."

This result is pretty much in accordance with my own calculations, where the volume of global net oil exports will fall to zero in 2025-2027, see the rest of this book.

In Jeffrey J. Brown's model, the volume of global net oil exports fell to zero somewhere between 2030 and 2032, depending on which of his articles you read, but, as I said, **he might not have taken into account the third exponential function**,

the exponentially falling EROEI, which "Crash Watcher" in the blogpost above calculated would fall from 20:1 in 2010 to 2:1 in 2030.

And now to the crucial issue: "*Charles A. S. Hall, who has studied EROEI for most of his career and published in Science and other top peer-reviewed journals, believes that society needs an EROEI of at least 12 or 13:1 to maintain our current level of civilization."* (From the blogpost Net Energy Cliff Will Lead to Collapse of Civilization, posted on December 11, 2019 by Alice Friedemann on the "Energy Skeptic" blog)

According to the article What is global EROI now? A Review of 2012 EROI of Global Energy Resources by Alice Friedemann, posted on January 16, 2013 on the blog "Energy Skeptic", EROEI was 18:1 in 2006, which is somewhat similar to the calculations of "Crash Watcher". I think we passed the 13:1-12:1 mark for global oil production (All Liquids) around 2018, at the latest, when All Liquids peaked, and the whole global civilization subsequently peaked, at the latest, with very conservative estimates. After that, it feels like the Big Collapse of civilization has already begun.

Global Net Oil Export mathematics, part 4: Diesel is the “Achilles heel” of the world economy. Therefore I try to calculate global net diesel export volumes after 2021

According to Jeffrey J. Brown in the article "The Road To Clean Energy Is Messier Than We Thought" from 14.10.2021, we had 30 mbd left of global net oil exports in the end of 2021. This is a very important starting point.

According to professional oil geologist Art Berman in Nate Hagens' interview with him recently, titled "Arthur Berman: “The Devil is in the Diesel” | The Great Simplification #44", about 20 % of a barrel of oil becomes, in the end, diesel. This is also fundamental for our calculations.

20 % of 30 is 6, so in 2021 we had 6 mbd of diesel exports left globally. But. When we know that shale oil has only very little diesel, and we know that shale oil comprises almost around 10 % of global oil production (only US produced 7.23 million barrels per day of shale oil in 2021, (put in perspective, "Global oil production (All Fossil Liquids) amounted to 89.9 million barrels per day in 2021"), there are several other countries which produce substantial amounts of shale oil, for example, "Canada’s production of shale oil in the country was approximately 335,000 barrels a day in 2018", and "Oil shale provides 70% of the energy supply in Estonia" (I think they should have written "shale oil", not "oil shale", the latter being much more costly to produce), and "China produced 35,000 barrels per day (bpd) of shale oil in 2021"), we actually have to subtract up to 3 mbd from the 30 mbd of oil exports we have, if we want to calculate future diesel export volumes, so we get 27 mbd of oil exports where diesel in turn comprises 20 % of it, and 20 % of 27 is 5,4. **So in 2021 the world had 5,4 mbd of global net diesel exports left**. This is a very important and good starting

point.

If we then assume a modest, pretty conservative **accelerated decline rate** of these 5,4 mbd (the decline rate accelerates, because the volume is squeezed **by three exponential functions**), we get these parameters:

1) Exponential decline in production. Let's take a 5 % decline rate per year **on average** (because Jeffrey Brown used this figure in his Export Land Model)**,** for the period 2021-2030. Observe that the production decline will begin very slowly, maybe at 2 % in a year (2 % of 102 mbd is 2,04 mbd. I think that the global oil production will soon fall with this amount every year), and then accelerate to about 6-7 % in a year in the end. According to Alice Friedemann in the YouTube interview with her titled "Alice Friedemann—Life After Fossil Fuels book—Derrick Jensen Resistance Radio 2021-09-05" "*80 % of oil production is declining at 8,5 % a year*", this is the natural decline rate, how much oil production would decline if we didn't add any new oil fields to production. Steve St. Angelo said in the YouTube video "Steve St. Angelo: The Financial World is One Giant Ponzi Scheme" on 22.10.2022 that this decline rate was 10 % for all oil production.

2) Exponential increase in consumption. Let's take a modest 2,5 % increase rate per year. *"The world's average GDP growth rate is equal to 2.9 %*" (this was in 2013, the quote is from the article "GDP growth rate - by country" on the website “mecometer.com”. For only 2022 the figure was about 3,4 %).

3) Exponential decline in EROEI. Let's take a 10 % decline rate per year for the period 2021-2030, starting from about 10:1 in 2021. (Observe: "*If we start at 50 and work our way down the ERoEI scale moving to the right, we see that energy invested (red) increases very slowly from 2% at ERoEI=50 to*

10% at ERoEI=10. But beyond 10, the energy invested increases exponentially to 20% at ERoEI=5 and to 50% at ERoEI=2. At ERoEI = 1, 100% of the energy used is spent gathering energy and we are left with zero gain." From the blogpost "ERoEI for Beginners", posted on May 25, 2016 on the blog “Energy Matters”, by Euan Mearns).

With these parameters we get the following results*: The global net diesel exports volume goes to zero **in five years after 2021**, i.e. in 2026, according to my pretty rough calculations (in 2027 **at the latest**, leaving room for optimism, but this date is not the result of any calculation). I estimate that the EROEI would be somewhere around 7:1-6:1 in 2026, for the whole global oil industry. The blog “Crash Watcher” calculates that EROEI will be around 2:1 in 2030 (this is when 50 % of the energy obtained will be invested in producing energy), see the article by “Crash Watcher” on February 13, 2011, “An Export Land Model Analysis for the USA-Part 4”. So with his calculations, it is reasonable to assume that EROEI globally is at most 7:1-6:1 in 2026. **As Euan Mearns points out in the graph below, 5:1-7:1 is the minimum requirement for society to function.** Veteran systems ecologist Charles A. S.Hall puts this already at 12:1 to 13:1 (See the blogpost Net Energy Cliff Will Lead to Collapse of Civilization, posted on December 11, 2019 by Alice Friedemann on the “Energy Skeptic” blog).

Thinking about how important diesel is to the world economy, being its “Achilles heel”, we should, when calculating global net oil exports, focus on global net diesel exports (1), because diesel is what really counts here. We can live without gasoline, without personal cars, but without diesel, trucks stop running, and the store shelves will soon be empty. The current global diesel shortage is a direct result of declining global net diesel exports, and not only because of the war in Ukraina.

The pace at which global net diesel exports decline right now, is flabbergasting. It declines so fast, that we could well see the world economy collapsing already in 2025, or 2026-2027 at the latest.

We should all begin to ration diesel, globally, planning for a post carbon future, and then it's vital to know how much diesel we will have globally in the years to come. That's why I have written this chapter.

If we don't subtract the shale oil from the 30 mbd of global oil exports (guessing that Brown's 30 mbd of oil exports didn't include shale oil), then we only win 10 % of the time from 2021 to 2030, which is one year, at most. This postpones the end of the diesel export market to 2027, at the latest.

Note also that my calculations in this blogpost doesn't take into account the "ten critical factors" which I added to my first post in this series.

* the following are my calculations with a modest accelerated decline rate, modest when taking into account that our data is squeezed by **three exponential functions** (I'm not able to calculate directly the effect of the third one here, I have only secondary school math in the backpack):

We begin with 5,4 mbd of global net diesel export volume. Observe that the volume of global net diesel exports has declined already since 2005, and is nearing the end of its depletion curve. In the end of a depletion curve declining at an accelerating rate, **decline goes very, very fast**. In our curve from 2005 the overall net oil export volume decline starts with about 0,4 mbd or 400 000 barrels per day of decline per year, on average.

In 2005, when there was about 6,4 mbd of global net diesel exports, the volume of diesel exports declined by on average 0,08 mbd, or 80 000 barrels per day per year. In the beginning of 2022 the decline is already 0,41 mbd or 410 000 barrels per day per year. In 2026 the decline is already 1,35 mbd or 1 350 000 barrels per day per year. The total net oil exports volume is declining at the same time by about 5-6 mbd every year. I will add a very substantial amount to the 5 % decline of diesel production per year and 2,5 % increase of diesel consumption per year, due to what I said in the 3) above about exponentially declining EROEI, but I will add the same amount every year, for simplicity's sake, and then the added decline of the falling EROEI will in fact increase at a slightly accelerated pace, as it also does in the Net Energy Cliff chart (2) below:

1:st year: 5 % of 5,4 mbd is 0,27 mbd in diesel production

5,4-0.27=5,13

2,5% of 5,4 mbd is 0,14 mbd in diesel consumption

5,13-0.14=4,99.

In 2022 we may have had 4,99 mbd of diesel exports left.

2:nd year: 4,99-0,54 (adding a certain amount because of the falling EROEI)=4,55

4,55-0,28=4,27 (adding a certain amount because of falling EROEI [3]).

In 2023 we may have 4,27 mbd of diesel exports left.

3:rd year: 4,27-081=3,46

3,46-0,42=3,04.

In 2024 we may have 3,04 mbd of diesel exports left.

4:th year: 3,04-1,08=1,96

1,96-0,56=1,40.

In 2025 we may have 1,40 mbd of diesel exports left.

5:th year: 1,40-1,35=0,05.

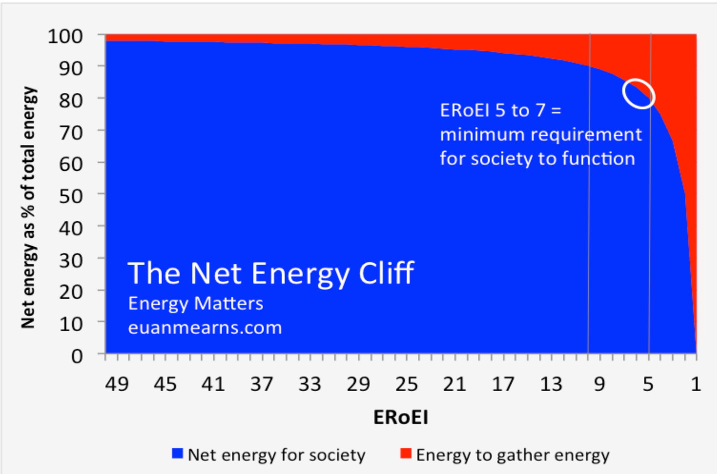
In 2026 we may have 0,05 mbd or 50 000 barrels per day of diesel exports left.

Note: As the late Albert Bartlett said, "*the greatest shortcoming of the human race is our inability to understand the exponential function*", and I would add that maybe an even greater shortcoming is our inability to understand the "accelerated rate of decline" function (these not being the same thing, according to official mathematics, although I use these two as synonyms in this book). How can diesel exports stop so quickly? I have

trouble believing my own calculations. This means a lot of empty shelves in 2025, one year before the doomsday year of Guy McPherson (4), for all the diesel importing countries.

(1) Unfortunately I don't find anyone on the internet having calculated global net diesel exports.

(2)



(3) the reason why I add so much as 0,27 and 0,13 mbd to the subtraction of the volume of net diesel exports in 2023 and even more further down, is that EROEI or the energy cost of energy invested, has risen with an accelerating rate throughout history, **and rises very fast in the end of the "Net Energy Cliff" curve**. So if EROEI is, as I calculate, around 9:1 to 8:1 in 2023, around 15 % of the energy obtained has to be invested in new energy production, and in 2026, at 7:1-6:1, 18 % has to be invested. 0,27 + 0,13 is much less than 15 % of 4,99 (15 %

of 4,99 is about 0,75), so if we would calculate the volume of diesel we would lose for every barrel to investment in new diesel production, it would be 0,75 mbd in 2021, i.e. 750 000 barrels per day in one year, and I account only for 400 000 barrels per day per year (the figure is rising somewhat in the coming years). Again, I use very modest and conservative numbers in my calculations. This make it very unlikely that we will have diesel exports beyond 2026, but I still leave some hope that we will still have some in 2027. If my calculations in former parts of this series are correct, i.e. that we lose overall net oil exports in 2025-2026, then we have 2027 as maybe the latest possible date when we have net diesel exports. But in the 2025-2026 period, we would have only around 1 mbd of diesel exports at most, and **it would quickly be consumed by China and India**. Can the world economy operate on 1 mbd of diesel exports? I really doubt that. Because there would be so little diesel to operate with in the end of the 2021-2026 period, in 2025 we would practically be bankrupt, leaving the at least 155 oil importing countries without diesel, perhaps with the exception of China and India, two countries which will, in 2025, consume all the available diesel exports on the market.

(4) "*There is a 90% chance that humanity will go extinct by 2026*." (professor Guy McPherson, quoted in the article "No Surrender? A Critique of Guy McPherson's Prediction of Near-Term Human Extinction" by Moti Nissani posted in March 5, 2017 on the blog "Uncommon thought since 2002"). The end of the diesel market might in fact happen in 2025, and then much of civilization pretty much stops, which will lead to loss of "global dimming", which will lead to extreme runaway global warming, which will make humanity extinct pretty fast. So McPherson's prediction is not very outlandish, it may contain a grain of truth, but my bet is on somewhere between 2030-2040 for the complete extinction of the human race, be-

cause some will survive for a long time in underground bunkers. That is, if the Second Coming of Jesus does not happen before that.

Global Net Oil Export mathematics, part 5: A more exact calculation of the end of the global diesel export market

I subtract 14,7 % from my number of overall oil export volume

According to this graph in the article "Monthly petroleum and other liquids consumption worldwide from August 2019 to August 2022, with a forecast until December 2023" (published by N. Sönnichsen, Oct 13, 2022 on the website "Statista"), the world produced, in August 2019, 102,06 million barrels per day (mbd) of All Liquid Fuels.

Around **at least** 14,7 % of this amount (this is a very conservative estimate), is shale oil (~10 %), natural gas liquids (NGL) and biofuels (peak crude+condensate in November 2018 was at about 84,5 mbd, according to EIA, see this article: Peak Oil is Here! World oil production peaked in 2018, posted on February 1, 2022 by Alice Friedemann on the blog "Energy Skeptic"), which all contains little diesel. So my subtraction of 10 % from the 30 mbd of net export oil that I did in part 4 of this series was too conservative, the real amount of subtraction should be around 14,7 %, and in this number I have taken into account the little diesel that is in shale oil, otherwise this number would be ~17%.

14,7 % of 30 mbd is ~4,4 mbd.

30 mbd – 4,4 mbd is 25,6 mbd.

20 % (a barrel of oil contains only 20 % diesel) of 25,6 mbd is 5,12 mbd.

THE EROEI calculations

Before we go to our actual calculation, let's review what EROEI will be for every year we calculate upon, and a few years before that, too. I base my calculations upon “Crash Watcher's” blogpost from February 13, 2011, “An Export Land Model Analysis for the USA-Part 4”, being, though, slightly more optimistic than him. We calculate a 0,7-0,8 points of yearly, linear decline here in EROEI (“Crash Watcher” calculates with a 0,9 points of yearly decline), which is about a 7-8 % decline rate per year of the overall decline from 10:1 to 2:1, in the beginning (which means that the cost of finding and producing energy rises with 7-8% every year). “Crash Watcher's” EROEI calculations are based on professor Charles A.S.Hall’s calculations. Our calculations are also in full accordance with Richard Heinberg's statement already in 20*14 that "costs of oil exploration/production is rising 10,9 %* per *year" (Douglas*-Westwood) (quoted from his 2014 lecture recorded on YouTube titled "Richard Heinberg on Snake Oil: How Fracking's False Promise of Plenty Imperils Our Future"). Or, in fact Heinberg is even more radical than us, because if the costs would rise 10,9 %, then EROEI would fall by about 10,9 % every year, instead of our 7-8 % (and remember that the costs rise with time, because this is an exponential rise). But, as usual, I want to be conservative in my calculations, because otherwise I have trouble believing my own calculations, everything changes so fast:

This is my estimates of the EROEI:s between 2020 and 2030:

2020: 10:1 (10 % of the energy obtained goes into producing more energy)

2021: 9,2:1: (11,7 % of the energy obtained goes into producing more energy)

2022: 8,5:1 (13,4 % of the energy obtained goes into producing more energy)

2023: 7,8:1 (15,1 % of the energy obtained goes into producing more energy)

2024: 7:1 (16,8 % of the energy obtained goes into producing more energy)

2025: 6,3:1 (18,5 % of the energy obtained goes into producing more energy)

2026: 5,5:1 (20,2 % of the energy obtained goes into producing more energy)

2027: 4,8:1 (21,9 % of the energy obtained goes into producing more energy)

2028: 4:1 (25 % of the energy obtained goes into producing more energy)

2029: 3:1 (33 % of the energy obtained goes into producing more energy)

2030: 2,5:1 (40 % of the energy obtained goes into producing more energy)

"...if (or when) ERoEI decreases to the 2:1 to 3:1 range, oil exports would rapidly decline to zero."

(from the blogpost "An Export Land Model Analysis for the USA-Part 4", February 13, 2011 on "Crash Watcher")

"Second, the ERoEI of the oil extracted from Bakken Shale and Eagle Ford is likely a lot lower than traditional oil reserves

(less than 2:1 according to Cleveland, in Oil Shale's Energy Return on Energy Investment or An Assessment of the Energy Return on Investment (EROI) of Oil Shale)."

(from the same blogpost)

My actual calculations

Then to my actual calculations of the remaining global net diesel export volumes after 2021:

The volumes we calculate are squeezed from three directions, from three exponential functions (mostly a repeat from part 4 in our series) ("Crash Watcher" puts it like this when he calculates the net oil export volume of the top ten exporting countries: "*Similarly, the ERoEI-adjusted net exports from the top ten, as a group, are the sum of a triple exponential effect: exponentially decreasing production; exponentially increasing domestic consumption, and, exponentially increasing energy expenditures to produce the petroleum*". From the blogpost "An Export Land Model Analysis for the USA-Part 3", 6.2.2011):

1) Exponential decline in production. Let's take a 5 % **average** decline rate per year for the time 2021-2030. I assume that the production of overall **conventional** crude oil declines at this rate between now and 2030 (on average), and it is the conventional crude oil that really matters, because the rest of the fossil liquids contains little diesel. But now to diesel volumes: 5 % of 5,12 makes 0,26, our starting point here. According to Alice Friedemann in the YouTube interview with her titled "Alice Friedemann—Life After Fossil Fuels book—Derrick Jensen Resistance Radio 2021-09-05" "*80 % of oil production is declining at 8,5 % a year*", this is the natural decline rate, how much oil production would decline if we didn't add any

new oil fields to production. Steve St. Angelo said in the YouTube video "Steve St. Angelo: The Financial World is One Giant Ponzi Scheme" on 22.10.2022 that this rate was 10 % for all oil production.

2) Exponential increase in consumption. Let's take a modest 2,5 % increase rate per year. 2,5 % of 5,12 makes 0,13, our starting point here. *"The world's average GDP growth rate is equal to 2.9 %"* (this was in 2013, the quote is from the article "GDP growth rate - by country" on the website “www.mecometer.com”. For only 2022 the figure was about 3,4 %).

3) Exponential decline in EROEI. We take here, anyway, a 0,7-0,8 points of yearly, average, linear decline here, which is about a 7-8 % decline rate per year, starting from about 10:1 in 2021)

(Observe: "*If we start at 50 and work our way down the ERoEI scale moving to the right, we see that energy invested (red) increases very slowly from 2% at ERoEI=50 to 10% at ERoEI=10. But beyond 10, the energy invested increases exponentially to 20% at ERoEI=5 and to 50% at ERoEI=2. At ERoEI = 1, 100% of the energy used is spent gathering energy and we are left with zero gain*." From the blogpost "ERoEI for Beginners", posted on May 25, 2016 on the blog “Energy Matters”, by Euan Mearns).

I begin my calculations with the year 2022:

2022: 5,12 mbd - 0,26 mbd = 4,86 mbd
4,86 mbd - 0,13 mbd = 4,73 mbd
13,4 % of 5,12 mbd = 0,66 mbd
4,73 mbd - 0,66 mbd = **4,07 mbd**

In 2022 we may have had 4,07 mbd of diesel exports left.

2023: 4,07 mbd - 0,28 mbd (0,26 growing with 5 %) =
~3,80 mbd
3,80 mbd - 0,133 mbd (0,13 growing with 2,5 %) =
~3,70 mbd
15,1 % of 4,07 mbd is ~0,70
3,70 mbd - 0,70 mbd = **3,00 mbd**

In 2023 we may have 3,00 mbd of diesel exports left.

2024: 3,00 mbd - 0,30 mbd = 2,70 mbd
2,70 mbd - 0,15 mbd = 2,55 mbd
16,8 % of 3,00 mbd is ~0,55 mbd
2,55 mbd - 0,55 mbd = **2,00 mbd**

In 2024 we may have 2,00 mbd of diesel exports left.

2025: 2,00 mbd - 0,32 mbd = 1,68 mbd
1,68 mbd - 0,16 mbd = 1,52 mbd
18,5 % of 2,00 mbd is 0,37 mbd
1,52 mbd - 0,37 mbd = **1,15 mbd**

In 2025 we may have 1,15 mbd of diesel exports left.

2026: 1,15 mbd - 0,34 mbd = 0,81 mbd
0,81 mbd - 0,17 mbd = 0,64 mbd
20,2 % of 1,15 mbd is 0,21 mbd
0,64 mbd - 0,21 mbd = **0,43 mbd**

In 2026 we may have 0,43 mbd of diesel exports left.

2027: 0,43 mbd - 0,36 mbd = 0,07 mbd
0,07 mbd - 0,18 mbd = 0

In 2027 we may have 0,00 mbd of diesel exports left.

Observe that the decline of oil exports in this calculation is slowing with time, the decline is not compounding, is not declining at an accelerated rate, as in the previous calculation, when we arrived at 2026 as the end of oil exports. I did this calculation to show you how we could arrive at the end of oil exports with very conservative parameters. So we gained only about one year in this calculation.

My previous calculations confirmed

As I said in the previous part (4), *"Again, I use very modest and conservative numbers in my calculations. This make it very unlikely that we will have diesel exports beyond 2026, but I yet leave some hope that we will still have some in 2027.*"

These new, more exact calculations, confirm what I said. And these new calculations are also very conservative, because according to Jeffrey J. Brown, oil exports decline **at an accelerated rate of decline**, and the decline in this decline curve is slowing with time. Remember that a curve with an accelerated rate of decline begins slowly, and goes very fast in the end, declines with 5 %, then 7 %, then 10 %, then 14 %, then 19 %, then 27 % and so on. My curve had its starting point already in 2005, when oil exports peaked, **so the pace of acceleration should be pretty fast already in 2021.** My first calculation of the volume of global net diesel exports after 2021 (in part 4 of this book), was much more in accordance with the accelerated rate of decline curve, than my calculations in this chapter. But the calculations in part 4 were rough, a guess work, mostly. I come to almost the same results as those in part 4, in my later calculations in this book, there is only a difference of about one year to half a year.

“Crash Watcher” wrote in 2011: *"Rather, the sum of exports from the top ten, as a group, are on a steady -6%/yr decline until hitting zero net exports in 2027."*

6 % yearly decline is an exponential decline, or an accelerated rate of decline, which means the same thing in this book.

Jeffrey Brown talks about this decline rate in this manner:

"So, the easy way to state it is: giving an ongoing, inevitable decline in production, unless an exporting country cuts their domestic oil consumption at the same rate as the rate of decline in production, or at a faster rate, it’s a mathematical certainty that the net export decline rate—what they actually ship out to consumers—will exceed the rate of decline in production. And, furthermore, it accelerates.

So, you look at exponential declines in oil production and hyperbolic—hyperbolic just means that the decline rate slows with time. Well, this is an accelerating decline rate. So, it’d start out like at 5% and then 10% and then 15% and 25%."

(from the article "To Understand The Oil Story, You Need To Understand Exports", by Chris Martenson and Jeffrey J. Brown, on the site “Resilience.org” on September 15, 2015).

“Crash Watcher”, surely, didn't account for the shale oil revolution in his estimates, it was too early for that (2011), so, if we account for that, we would maybe anyway land on something like 2028 as the end of the oil exports for the top ten exporting countries. Pretty much the result of my own calculations, maybe only plus one year.

Observe that I also, in my calculations in this chapter, did not account for my "ten critical factors" referred to in the chapter “*Global Net Oil Export mathematics, part 1: How I calculate the end of the oil export market*” of this book.

And observe also, that I did not take “ANE” into account, i.e. “available net exports”, which is global net oil exports minus China and India’s net oil imports. The end of “ANE” could come at most a couple of years before “GNE” (“Global Net Exports”, which is overall oil exports), i.e. in 2025, or, at worst, in 2024. But 2024 feels too radical.

Global Net Oil Export mathematics, part 6: Calculating diesel exports with other parameters.

I subtract 30 % from my number of overall oil export volume instead of 14,7 %

According to this graph in the article "Monthly petroleum and other liquids consumption worldwide from August 2019 to August 2022, with a forecast until December 2023" (published by N. Sönnichsen, Oct 13, 2022 on the website Statista), the world produced, in August 2019, 102,06 million barrels per day (mbd) of All Fossil Liquid Fuels. It is confirmed in the blogpost "The EIA's Short-Term Energy Outlook" 11/25/2022 by Ron Patterson on the blog "Peak Oil Barrel".

Not 14,6 %, but around at least 30 % of this amount, is a combination of shale oil (~10 %), natural gas liquids (NGL), biofuels, refinery process gains, and other unspecified liquids. Conventional oil production only was at 70 mbd at its peak 2008, according to the article "Conventional Oil Production" on June 17, 2014 on Peak Oil News & Message Boards, and has risen only slightly since, peaked still another time in 2016, and is now falling. See also the graph below*,from the article "Peak Oil is Here! World oil production peaked in 2018", posted on February 1, 2022 by Alice Friedemann at the blog "Energy Skeptic".

Shale oil contains only little diesel, and the other "oil liquids" in unconventional oil barely contain any diesel at all. So my subtraction of 14,6 % from the 30 mbd of net export oil that I did in part 4 of this series was way too conservative, the real amount of subtraction should be 30 %. There may be a little diesel in shale oil, but it is accounted for in this estimate.

30 % of 30 mbd is 9 mbd.

30 mbd - 9 mbd is 21 mbd.

20 % (a barrel of oil contains only 20 % diesel) of 21 mbd is 4,2 mbd.

My actual calculations

Then to my actual calculations of the remaining global net diesel export volumes after 2021:

The volumes we calculate are squeezed from three directions, from three exponential functions (mostly a repeat from part 4 in our series) ("Crash Watcher" puts it like this when he calculates the net export volume of the top ten exporting countries:

"*Similarly, the ERoEI-adjusted net exports from the top ten, as a group, are the sum of a triple exponential effect: exponentially decreasing production; exponentially increasing domestic consumption, and, exponentially increasing energy expenditures to produce the petroleum*".

(From the blogpost "An Export Land Model Analysis for the USA-Part 3", 6.2.2011):

1) Exponential decline in production. Let's now take a modest 2,5 % average decline rate per year, instead of the 5 % we counted with in the previous parts of this series. I assume that the production of overall conventional crude oil will decline in the future at the double this rate going forward, [it is the conventional crude oil that really matters, because the rest of the unconventional oil liquids contain little diesel], but **to be on the safe side**, let's take 2,5 %. I try always to be conservative in these calculations, so I can believe my own calculations. But

because this is an exponential decline, with which I mean an accelerated rate of decline, the decline will be very steep in the end, when we go over the “Energy Cliff”, so I will end up with a 6 % decline rate in 2028.

But now to diesel volumes: 2,5 % of 4,2 makes 0,1, our starting point here. According to Alice Friedemann in the YouTube interview with her titled "Alice Friedemann—Life After Fossil Fuels book—Derrick Jensen Resistance Radio 2021-09-05" "*80 % of oil production is declining at 8,5 % a year*", this is the natural decline rate, how much oil production would decline if we didn't add any new oil fields to production. Steve St. Angelo said in the YouTube video "Steve St. Angelo: The Financial World is One Giant Ponzi Scheme" on 22.10.2022 that this rate was 10 % for all oil production.

2) Exponential increase in consumption. Let's take a modest 2,5 % increase rate per year. 2,5 % of 4,2 makes 0,1, our starting point here. *"The world's average GDP growth rate is equal to 2.9 %*" (this was in 2013, the quote is from the article "GDP growth rate - by country" on the website “www.mecometer.com”.For only 2022 the figure was about 3,4 %).

3) Exponential decline in EROEI. We take here, anyway, a 0,7-0,8 points of yearly, average, linear decline, which is about a 7-8 % decline rate per year, starting from about 10:1 in 2021) (Observe: "*If we start at 50 and work our way down the ERoEI scale moving to the right, we see that energy invested (red) increases very slowly from 2% at ERoEI=50 to 10% at ERoEI=10. But beyond 10, the energy invested increases exponentially to 20% at ERoEI=5 and to 50% at ERoEI=2. At ERoEI = 1, 100% of the energy used is spent gathering energy and we are left with zero gain*." From the blogpost "ERoEI for Beginners", posted on May 25, 2016 on the blog Energy Matters, by Euan Mearns).

I calculate again, beginning with the year 2022:

2022: 4,2 mbd - 0,1 mbd = 4,1 mbd
4,1 mbd - 0,1 mbd = 4,00 mbd
13,4 % of 4,2 mbd = 0,56 mbd
4,00 mbd - 0,56 mbd = **3,44 mbd**

In 2022 we may have had 3,44 mbd of diesel exports left.

2023: 3,44 mbd - 0,125 mbd (0,1 growing with 2,5 %) = ~3,315 mbd
3,315 mbd - 0,125 mbd (0,1 growing with 2,5 %) = ~3,19 mbd
15,1 % of 3,44 mbd is ~0,52
3,19 mbd - 0,52 mbd = **2,67 mbd**

In 2023 we may have 2,67 mbd of diesel exports left.

2024: 2,67 mbd - 0,128 mbd (0,125 growing with 2,5 %) = 2,542 mbd
2,542 mbd - 0,128 mbd = 2,414 mbd
16,8 % of 2,67 mbd is ~0,45 mbd
2,414 mbd - 0,450 mbd = **1,964 mbd ~1,96**

In 2024 we may have 1,96 mbd of diesel exports left.

2025: 1,96 mbd - 0,131 mbd (0,128 growing with 2,5%) = ~1,83 mbd
1,83 mbd - 0,131 mbd = ~1,7 mbd
18,5 % of 1,96 mbd is ~0,36 mbd
1,7 mbd - 0,36 mbd = **1,34 mbd**

In 2025 we may have 1,34 mbd of diesel exports left.

2026: 1,34 mbd - 0,134 mbd (0,131 growing with 2,5%) = 1,26 mbd

1,26 mbd - 0,134 mbd = 1,126 mbd
20,2 % of 1,34 mbd is 0,27 mbd
1,126 mbd - 0,27 mbd = **0,856 mbd ~0,86**

In 2026 we may have 0,86 mbd of diesel exports left.

2027: 0,86 mbd - 0,14 mbd (0,134 growing with 4%) =

0,71 mbd

0,71 mbd - 0,14 mbd = 0,57 mbd

21,9 % of 0,86 mbd = 0,19 mbd

0,57 mbd - 0,19 = **0,38 mbd**

In 2027 we may have 0,38 mbd, or 380 000 barrels of diesel exports left.

2028: 0,38 mbd – 0,142 (0,134 growing with 6%) = 0,238 mbd

0,238 mbd – 0,144 = 0,094

25 % of 0,38 mbd = 0,095

0,094 – 0,095 = 0

In the end of 2028 we have zero barrels of diesel exports left.

Already in 2027, the 0,32 mbd amount of diesel exports will quickly be swallowed up by China and India. We might have a little diesel exports going into 2028 as well. But during 2026-2027, we may well run out of **available** net diesel exports. This is according to very conservative calculations. It could happen

even before that, in the end of 2025. Because (see the chapter "The end of "Available Net Exports" ["ANE"] in the oil export market" later in this book) the "ANE" declines, in the beginning, at more than double the rate as "GNE" ("Global Net Exports", the overall net oil exports), and should do it also further on.

Epilogue: Global collapse may begin 2026, at the latest

The calculations in this chapter, now with different parameters, "being on the safe side", are pretty much a confirmation of my previous calculations. I came almost to the same conclusions here as in part 5. **Only maybe one year, almost two, differed**, that's not much in the grand scheme of things. The calculations were again conservative, I used a conservative, very modest estimate of the average decline of conventional oil production between now and 2030, only 2,5 % per year (think about this: from 2019 to 2020 global oil production declined with at least 14 % because of the pandemic), with an acceleration in the end. And then I didn't take into account my "ten critical factors" referred to in part 1. **These factors are really, really important**. So this is again almost a best-case scenario. I see no possibility that there will be any diesel exports beyond 2027-2028. That's the upper limit.

Remember now that in the peak days of diesel exports, in 2005, we had about 6,4 mbd of global net diesel exports (30 % of 46 is 13,8. 13,8 subtracted from 46 = 32,2. 20 % of 32,2 mbd is 6,4, 6,4 x 5 is 32,2, we had 46 mbd of overall export oil back then), today (2023) we have about 2,67 mbd left, **having a global diesel shortage** and then, 2026, we will have only about 0,86 mbd, or 860 000 barrels of diesel exports left. This is a decline of over 86 % from 2005 (0,86 is 13,4 % of 6,4), it's only about 1/9 of what we had in 2005. This is really, really serious.

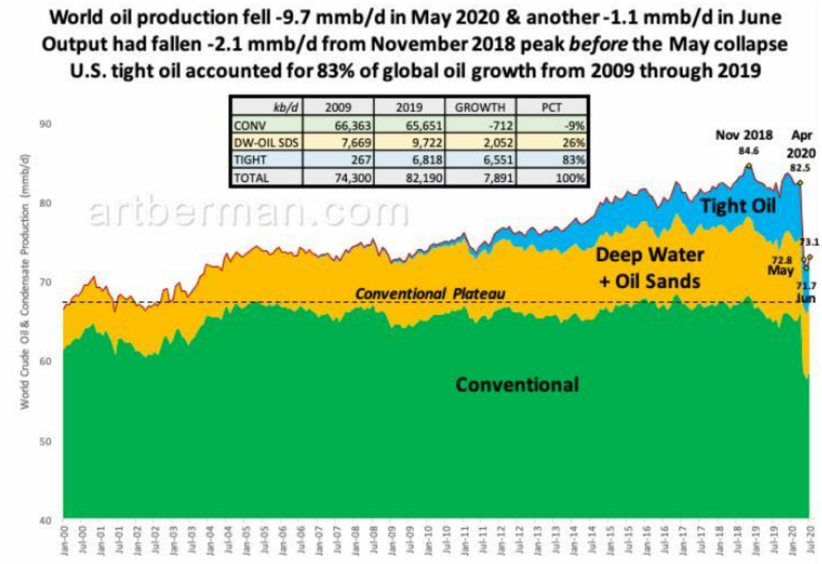
Remember that at least 155 countries in the world are dependent on oil imports in the world (almost three of four countries), and thus also on diesel imports. At least 155 countries, probably more, have to share 860 000 barrels of diesel exports in 2026! Just think if three-quarters of the world's shipping industry vanished in 2026! It's mindboggling. And that's just one industry that needs diesel. I would say that at the latest, global industrial civilization will begin to collapse by then or by 2027. And by collapse I mean when many trucks stop running and many grocery store shelves are empty. And that is precisely what will happen when we run out of diesel, because trucks run on diesel. The global diesel shortages have begun already (I wrote this in the end of 2022), but **they will continue to get worse and worse for four long years** until global civilization collapses with a “long bang”, probably because diesel shortages will pop "the Everything Bubble". Then the whole domino card house will fall, and fall steeply, because we kicked the can down the road so far with monetary stimulation, debt and "enhanced oil recovery", among other things. The shale oil bubble or the “Shale Ponzi Scheme” will collapse, and contribute a lot to the popping of the Everything Bubble.

And this is still almost a best-case scenario, in my opinion. So many things could go wrong before that.

I have trouble believing my own calculations, so strange are the results. But I have to follow the data, wherever they lead.

Prepare yourself for austere times.

*



World oil production fell -9.7 mmb/d in May 2020 & another -1.1 mmb/d in June
Output had fallen -2.1 mmb/d from November 2018 peak before the May collapse
U.S. tight oil accounted for 83% of global oil growth from 2009 through 2019
kb/d 2009 2019 GROWTH PCT
CONV 66,363 65,651 -712 -9%
DW-OIL SDS 7,669 9,722 2,052 26%
TIGHT 267 6,818 6,551 83%
TOTAL 74,300 82,190 7,891 100%
artberman.com
World Crude Oil & Condensate Production (mmb/d)
Nov 2018
84.6
Apr
2020
82.5
Tight Oil
Deep Water
+ Oil Sands
73.1
72.8
May
71.7
Jun
Conventional Plateau
Conventional

Global Net Oil Export mathematics, part 7: Some final notes

"I think overall we could be down to half of our oil that we produce today by 2035."

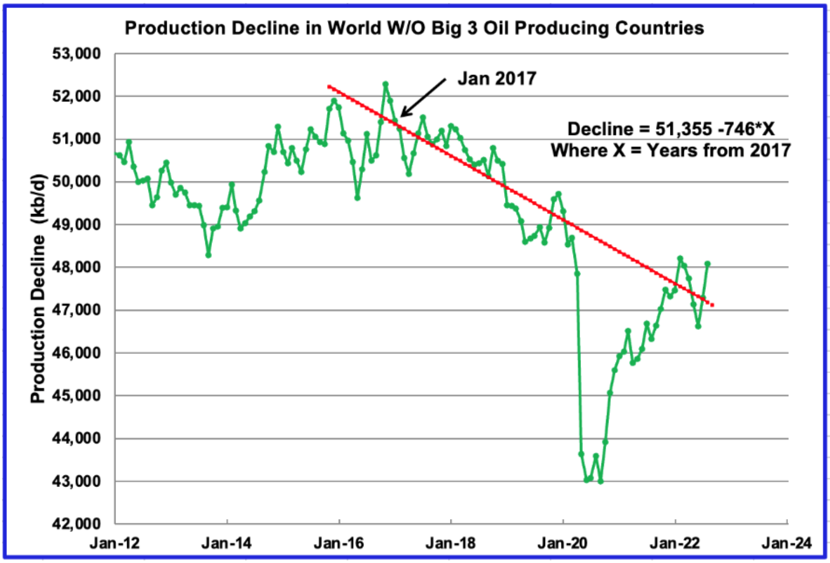
(From Derrick Jensen's interview with Alice Friedemann (she is the one who operates the blog "Energy Skeptic") one year ago, titled "Alice Friedemann—Life After Fossil Fuels book—Derrick Jensen Resistance Radio 2021-09-05")

This is confirmed by Steve St. Angelo at SrsRocco Report:

IT'S OFFICIAL U.S. SHALE OIL BOOM IS NOW OVER: Shale Oil Production To Collapse 50-75% By 2035 (November 27, 2022)

* * *

The following graph and text is from the blogpost "Permian Pushes US September Oil Production to Post-Pandemic High" 12/02/2022 on the blog "Peak Oil Barrel":



"This chart shows the production decline in the world without the Big 3, US, Russia and Saudi Arabia over the period January 2017 to August 2022. February 2020 to September 2021 was left out of the analysis for the OLS line. The annual decline rate is 746 kb/d/yr."

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746 kb/d/yr is a decline rate of about 1,43 % per year. I think this chart shows crude + condensate (as it does in the other charts in the blogpost), which is also counting shale oil. Conventional oil alone is declining a little faster, let's say 1,5 % every year. All countries/crude + condensate have a slower decline rate, maybe 1 % per year since November 2018. All countries/only conventional oil, have an estimated decline rate of 1,3 % per year. This decline rate increases for every year, starts with 1,3% in 2018, and ends with an estimated decline rate of 6 % in 2028 (the decline will probably increase exponentially, because of the imminent collapse of civilization and the subsequent collapse of the oil industry), 10 years later, by

then we will lose about at least 4 mbd (million barrels per day) of oil production per year [of crude+condensate, not "All Liquids]). For the whole period 2018-2028 the average decline rate is **at least** an estimated 2,5 %, so my estimate in part 6 of this section of this book of a 2,5 % decline rate for every year is more than justified, it is perhaps the minimum average decline rate that is possible for the period, so high the decline rate will be in the end of it. These calculations are also in harmony with Alice Friedemann's calculations above. If Alice is correct, the decline rate in 2035 has to be somewhere between 8-10 mbd per year, a situation where the global oil industry will be able to only marginally offset the natural decline rate of oil production, which by then will be about 14 mbd per year (see the calculations below). Still we have to find and bring into production at least a new Ghawar (the world's largest oil field, in Saudi Arabia, it pumped once about 5 mbd) every year in order to keep the decline rate at 8-10 mbd/per year. Alice Friedemann also says in the radio interview above on YouTube that *"80 % of oil production is declining at 8,5 % a year*", which means a decline of about 8,7 mbd/per year of oil (counting "All Liquids"). This was over one year ago, and Alice also says in the same video, that "*the rate of decline (of oil) keeps increasing exponentially. On top of that we haven't hardly found much oil in the past 7 years."*

This feels really hard to believe. Not only oil exports are declining exponentially, but also overall oil production. And remember that oil exports declines a lot faster than oil production.

World oil production has an estimated natural decline rate (the decline rate if no new exploration is undertaken and no new wells are drilled) of 10,5 mbd per year during the years 2015-2025, according to Steve St. Angelo's calculations on the blog "SrsRocco Report". During the years 2025-2035 the figure is estimated to be at least 14 mbd per year, extrapolating from trends since 1965 (see the YouTube video "Oil Prices Will

Never Crash Again now That OPEC is in the Drivers Seat as Shale Dies" from 3.12.2022, 14.00 minutes into the video). This means that in 2028, which is my calculated latest end point for oil exports, 10 million barrels of oil from newfound oil and new oil wells has to be produced just to stay at the 6 % a year decline rate which I calculated for 2028. If we produce less new oil, the decline rate will increase. But I think they could manage that, if they really make a mighty effort. But it means that they have to bring into production about as much as Russia produces, every year, 10 mbd every year.

If we want to keep the yearly decline rate at even lower levels than 6 % in 2028, say at 3 or 4 %, we have to bring into production even more, maybe as much as US produces, every year (12,3 mbd). With a collapsing economy and a collapsing civilization, this just would require too much. I don't think it's feasible.

So, therefore I believe that my previous calculations in the earlier parts of this series are justified and confirmed by this chapter.

The oil imports of the great empires: US, EU, China and India. More Global Net Oil Export mathematics. Part 8.

(This sad article, written many months after the previous content in this book (in 8.5.2023) can very well be read to the tunes of the exceedingly sad and romantic song Like a Tattoo, by Sade. How I love you all, collapsniks and peakoilers!)

Study this list of 85 oil importing countries.

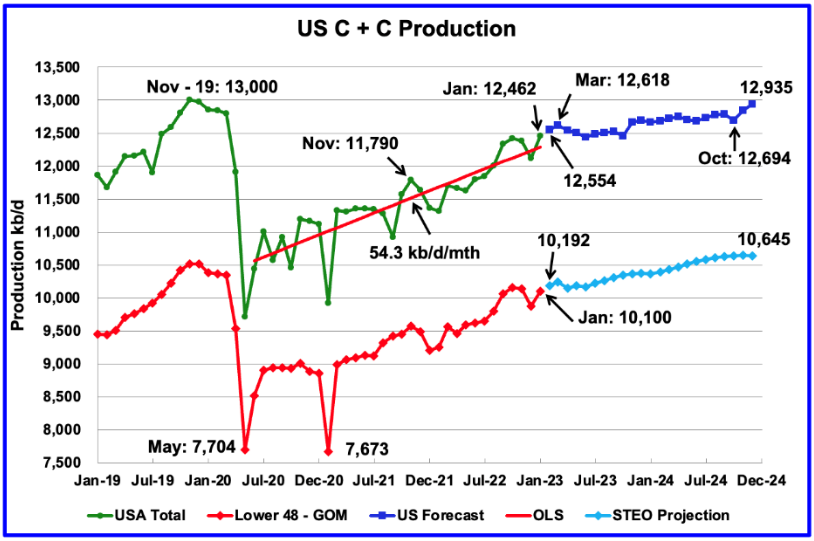
The US as a net oil importing country

The US imports little (in net oil import values) oil nowadays, according to some sources on the internet. Maybe those who say that US does not import much oil (net oil import is in question), are wrong. After all, the US consumes over 20 million barrels of oil per day ("*In 2022, the United States consumed an average of about 20.28 million barrels of petroleum per day*", this article states), and produces only up to 12,5 million barrels itself of crude + condensate. NGL, natural gas liquids, is not counted here, this and several other strange "oils" (things like biofuel and refinery gains) comprise about 40 % of US "oil", according to oil geologist Art Berman. But since NGL and the other "oils" **do not contain diesel**, we should take them into our calculations only with this very important fact in mind.

So US could in fact import up to 7,5 million barrels per day in 2023, if we do not count NGL, biofuels and refinery gains.

If we also count NGL + strange "oils" (NGL+), then US in fact does not import much (40 % of 20.28 mbd is at least 8 mbd), but it is tricky, **it fools us to think everything is okay.** But since NGL and the other strange "oils" do not contain diesel, they are pretty worthless for the real work in society, for trucks and ships and things that really make something. Therefore we

count them here only with this in mind. The NGL+ factor creates trouble, because I don't know if NGL+ is also counted in the oil import numbers of the other countries further down in this chapter. This makes my calculations messy. But I have to stick with the numbers I get, and conclude that my numbers are conservative, because **there always lurks some big amounts of NGL+ in there**. We have to count the NGL+ of the US in order to be fair to the numbers of the other countries, and I also notice that I do not easily get the numbers to line up with Jeffrey J. Browns estimates of the available net oil exports in 2021 (30 mbd) if I do not count the US NGL+.



(this graph is from [this blogpost](#) on the blog "Peak Oil Barrel" on 11.4.2023)

Net oil imports outside of US

Outside of US we are left with three big importers of oil, all big empires: the EU, China and India.

The EU imported 13.5 million barrels per day in 2021, according to this article. I don't think the amount of imports has fallen since then.

China imported roughly 10 million barrels per day in 2022 according to this article. This number is increasing rapidly.

"India's crude imports averaged 4.5 million bpd in January," (2022), according to this article. This number is also increasing rapidly.

So, now we have the needed numbers, and we can begin to calculate:

How much net oil exports does these four empires consume, US, EU, China and India?

US: only a very small amount, which is difficult to calculate, + EU: 13,5 mbd, + China: 10 mbd, + India: 4,5 mbd = a total of 28 mbd of oil imports.

If Jeffrey J. Brown is correct in this article (on October 14, 2021), and the world had only 30 mbd of oil exports in the end of 2021, then we are still at around 30 mbd of oil exports today, and the rest of the world have to share only 2-3 mbd of oil exports. This seems unlikely. And probably the amount of total crude oil exports has gone from 30 in the end of 2021 to 28 in the early 2023. At least.

From where did Brown get this 30 mbd number of oil exports? I think he got it because he counted only crude + condensate,

where the diesel lies. Therefore I have to subtract the non-crude/condensate from this at most 28 mbd of oil exports that I got for 2023 (because the numbers of oil imports in our four empires probably accounted for “All Liquids”), and the amount of oil that is not crude + condensate is about 17 %. For confirmation, see the numerous graphs on the blog “Peak Oil Barrel”.

Well, 17 % of 28 mbd is 4,76 mbd. Then we subtract 4,76 mbd from 28 mbd and we get 23,24 mbd. This is a more reasonable number. Then the world outside of our four empires (US, EU, China and India) gets to share 6,76 mbd of oil exports in 2023.

But if we **only count conventional oil**, which is also the type of oil Brown could have intended with his 30 mbd number, and also is what really counts here (most unconventional oils and also condensate are not at all as valuable in the refineries as real conventional crude oil), then we have to take 30 % of 28 mbd away. 30 % of 28 is 8,4. Furthermore, 28 - 8,4 is 19,6. Then the number is even more reasonable, and then the world outside of our four empires gets to share 8,4 mbd in 2023. Think: all the oil import countries in most of Asia, all of Latin America and all of Africa get to share only 8,4 mbd of oil exports in 2023.

This 8,4 mbd number is the real thing here. **It is what the big four empires want to consume**, more and more as time goes by. As the domestic oil consumption rises, and global oil production falls, all want these 8,4 mbd of oil exports that goes nowadays to the poorest countries in the world.

Can you then better understand why Jeffrey J. Brown in this long interview (somewhere in the middle of the article) in 2015 said that in 2032 China and India would together consume all of the remaining oil exports on the global market? Do you understand how fast these countries are growing? In 2022 China

had a bad year, and according to the president of China it grew during that year by 4,4 %. See this article. And India is growing even faster: *"India's gross domestic product (GDP) for financial year 2021-22 expanded to 8.7 per cent, highest in 22 years in terms of back series data."* (from this article).

If we only put an average value of 5 % annual growth for Chindia (China and India combined), for the period 2022-2032, and assume that their combined oil imports will grow with 5 % annually, from 14,5, then the oil imports grow in the first year (2023) with 0,72 mbd, to 15,22, and the following year (2024) to about 16 mbd, and the following year (2025) to about 16,8, and the following year (2025) to about 17,64, and the following year (2026) to about 18,54, and the following year (2027) to about 19,46, and the following year (2028) to about 20,43, and the following year (2029) to about 21,45, and the following year (2030) to about 22,52, and the following year (2031) to about 23,62, and the following, last year to about 24,80.

So, 2032 Chindia could theoretically consume 24,80 mbd of the available oil exports on the global market. Because GDP growth and oil consumption is tightly linked, history has shown.

24,80 mbd. This leaves us with 3,2 mbd of oil exports for the rest of the world in 2032. But **remember that the rest of the world is also growing its GDP**, is also growing its oil consumption. And remember also that the volume of oil exports available on the global market, not accounting for Chindia's imports, declines during this same 2022-2032 period. With about one mbd every year, at least, on average. And the decline accelerates. So that it declines from 28 mbd in 2023 to 10-15 mbd in 2032, with very conservative estimates.

And somewhere on the way Chindia's consumption crosses paths with the rest of the world on the decline curve of the

total amount of <u>available oil exports</u> on the world market. If we have at least 10-15 mbd of net oil exports in 2032 not counting Chindia's imports, and Chindia needs 24,80 mbd in 2032, you see that this crossing **will happen <u>well before</u> 2032.**

Therefore this 2032 number of Brown **is a best case scenario.** In this book I concluded that **available** net oil exports (which means global net oil exports minus Chindia's net oil imports) will reach zero already in 2027, if we are lucky. It rhymes very well with the conclusions of this chapter.

Jeffrey J. Brown calculated this (the end of global net oil exports in 2032) already ten years ago, or more, and it is remarkable how everything follows in the tracks of his calculations. The only thing is that **he was maybe too conservative**, but this may have been because he didn't account for EROEI decline, and followed what the official data said, in his calculations, that he built on official, corporate and government data, which have the tendency to overstate how much oil we have.

Conclusion

However I massage the data and hope (or not hope) for a prolonged time for civilization to exist, I always reach the end of global oil exports somewhere around 2030, as a best case scenario, exactly where Jeffrey J. Brown and **almost all the others who have calculated**, have ended.

Prepare accordingly.

Global Net Oil Export mathematics, part 9: Still one more final remark

Although I have tried to calculate the end of the global oil export market, I do not believe that reality will follow my calculations. I do not think it's even possible to calculate exactly what will happen in the oil export market, because the oil exporting countries will not cease their exports when the end of the oil exports market is in sight in the middle of this decade, **they will probably instead begin to export oil <u>from the volume of oil they consume themselves</u>**, thus, by shrinking their own economy more and more, saving the oil importing nations for the day, just as the rich countries today are aiding the collapsing poor countries, a little like we in EU have helped Greece from collapsing completely. This will postpone the end of the oil export market, but it will not postpone the collapse of global civilization by much. These coming acts of saving the collapsing countries will just make us all go down together pretty much at the same time, instead of some going down and some staying afloat. So I do not regret my prediction in the epilogue of part 6 of this book, that "*global collapse may come 2025, or 2026 at the latest*". At least the collapse starts by then. Isn't some form of collapse underway already? One and a half month ago (31.10.2022) Tsvetana Paraskova wrote in an article on "OilPrice.com" that the diesel shortage is just worsening. Will it not worsen still as the time goes by? **Especially considering the shrinking amount of oil exports**, OPEC:s and Russia's oil cuts and the EU oil embargo and the coming dramatic EU ban on imports of Russian refined oil products like diesel? (See the article "Russia Is Feeling the Pain of Europe's Oil Embargo" by Julian Lee on 11 December 2022 on Bloomberg). Yes, I believe that we will slowly collapse more and more until the Collapse is a visible fact for all to see. Then nobody will be able to deny it. We will all talk about it then. And then the stock market will finally have an epic crash, the debt market

will implode and the Great Collapse of Global Industrial Civilization will begin. We have four years at most (I wrote this in 2022). Four years to prepare. Please, prepare physically and mentally/spiritually. The spiritual side of preparation is the most important. Stock up on food. Make peace with death. Because death for most people will be premature.

But the conclusions I have reached in this book are difficult to believe. Still, I have to follow the data wherever they go.

P.S.(added 24.7.2023): One thing that may also buy us time is that oil consumption probably will decline in the future, more and more, exponentially, beginning already in the middle of this decade. So it is therefore not realistic to assume that oil consumption will increase by 2,5 % (as I assumed in this book) every year up to 2030. But this factor will probably partly be swallowed up by the fact that oil production also will fall exponentially (at an accelerated rate of decline), which neither is accounted for well in this book, it is difficult to predict how fast this will go.

But all in all, this will probably only buy us a few years of time, not more. So, if the mean date was about 2025 in this book for the end of global net oil exports (my estimates spanned from 2023 to 2027), then we will arrive at 2027 anyway, which was my conclusion in the preface, and 2030 at the latest, which was Jeffrey J. Browns estimate.

SECTION 2: Material added later to this book

Some more perspectives on the end of global net oil exports

"The two observations above led Brown to develop what he dubbed the Export Land Model. It was a simple model that seemed to explain a lot. Here's how he set up his first case: Brown assumed that a hypothetical oil exporter–which he designated as Export Land–had reached its peak in oil production. He assumed that domestic users in Export Land consumed half of all the oil the country produced. He then assumed a 5 percent annual decline in the rate of oil production and a 2.5 percent annual increase in domestic consumption. The results astonished and troubled him. In just nine years oil exports from Export Land went to zero."

(from Kurt Cobb's article "Global oil exports in decline since 2006: What will importing nations do?" on September 23, 2012, on his blog "Resource Insights")

There were totally 33 countries that represented 99 percent of the globe's net exports in 2012. If we assume that their exports will go to zero around 2030, as oil geologist Jeffrey J. Brown assumed in 2012, what could be the parameters for the decline of their exports? Let's try to get some perspectives on this.

Let's assume that the peak of net oil exports of these 33 countries really was in 2005 at 46 million barrels of conventional oil per day, as Jeffrey J. Brown has suggested, and that this volume reaches zero in 2030.

First, let's do this thought experiment:

When does this volume of export oil reach zero if the annual decline rate of oil production is only 2 % of the original 46 mbd of oil exports volume **all the way from 2005 to 2030**, and if the volume is declining by the same amount every year?. It

gets too complicated for me if I count on a 2 % yearly, compounding decline, year-over-year. But let me be clear, in reality the decline rate will be **at least** 2 % and compounding, from 2019 and onwards, compounding meaning that the decline accelerates for every year. Dr. Tim Morgan uses this 2% compounding decline rate on overall oil production from 2019 and onwards, in a comment to this article on 17.7.2023 on his blog "Surplus energy economics", read the whole comment in (1) below this article.

And what if the annual increase in oil consumption of these 33 countries together is 2 % of the original 46 mbd, and by the same amount every year (it gets too complicated for me if I count on a 2 % yearly increase, year-over-year)?

These percentage numbers are small compared to those used in the previous chapters of this book. The reality is that the decline rate of oil production accelerates with time, in an accelerated rate of decline curve. So does also the decline of net oil exports, which declines at an even faster rate than the decline of overall oil production. But this is only a thought experiment.

This is how I calculate the result:

We have 25 years. How many mbd is the yearly decline if we go from 46 to 0 in 25 years? 46/25 = 1,84. Answer: 1,84 mbd, which is 4 % of the original amount, the same every year.

The 33 oil exporting countries need only to have an annual oil production decline rate of 4 % of the original amount of oil export per year (and decline by the same amount every year), from 2005 to 2030, to go to zero oil exports in 2030, **if we only subtract oil production decline**, not adding the loss of oil exports to rising oil consumption and falling EROEI, these having, in fact, an immense significance. Observe that in real life, oil production decline is exponential, i.e. following an accelerated rate of decline curve, so also the decline of oil exports, yes

even much more so. And this acceleration goes really fast in the end.

For comparison: UK:s oil production fell by **7.8 percent year-by-year** from its production peak until it became a net oil importer (see this article). This is also close to the rate in which oil production is projected to fall at some time after we hit the “Energy Cliff” (this is largely because of "enhanced oil recovery" and the very steep decline rates of shale oil after its peak), and something of that magnitude is the natural decline rate of the oil fields of the world (all lumped together) if we didn't find and drill new wells or maintained our existing wells.

So, 1,84 mbd was 4 % of 46 mbd. What is then 2 % of 46 mbd? Answer: 0,92 mbd. How much is 25 X 0,92 mbd? Answer: 23 mbd. So we lose, in this thought experiment, a whopping 23 mbd in 25 years, from 2005-2030, **only to oil production decline** of 2 % of the original amount, if it only declines by the same amout every year! This is without accounting for a rising oil consumption or a falling EROEI.

What about the increase in consumption? If we have 25 years, and 46 mbd, and the internal oil consumption of the 33 oil exporting countries increases with only 2 % of the original amount of oil exports, yearly, and by the same amount every year? How many barrels of oil exports have been consumed when we reach 2030? Answer: the same as we got when I calculated the oil production decline. I.e. 23 million barrels of oil exports are consumed between 2005 and 2030 with an only 2 % yearly increase of consumption of the amount of oil exports that we have, by the 33 oil exporting countries, between 2005 and 2030, if the increase is by the same amount every year. 46 - 23 = 23. So around half is consumed **only by rising consumption**. Don't forget that **exponentially declining overall**

oil production is also eating our cake in this thought experiment! And we haven't even accounted for the exponentially falling EROEI!

For comparison, **in 2022 the world's <u>foremost oil exporter</u>, Saudi Arabia, grew it's economy by 8,7 %** (see [this article]()). And probably it grew its oil consumption by somewhat similar percentage numbers, because "*energy is the economy*" (Chris Martenson's slogan).

Now, 23 mbd + 23 mbd is 46 mbd, the amount we started with. Maybe it was by somewhat similar means that Jeffrey J. Brown thus got to the year 2030 as the end date of global net oil exports. What he forgot, and what I think perhaps was his main fault, was to forget to subtract the amount of exponential EROEI decline that is a very important factor in all Peak Oil math. Accounting for this is what makes us lose a few more years, and gets us to end up with 2025 and 2026, not 2030, in our thought experiment, which I use, among other things, to illustrate how important it is to account for all factors when we calculate the end of global net oil exports, and to give an example of how one can come to the same results as I have arrived to before in this book.

The loss to falling EROEI is also easy to calculate. The average loss of oil lost to EROEI decline, varies between about 5 and 20 % for the period 2005-2026, and is on average 12,5 %. So, 12,5% of 25 (Browns date, 2030, is 25 years after 2005) is 3,1. We lose 3,1 years of oil to falling EROEI.

2030 minus 3,1 is in the end of 2026. And when we then take "available net exports" ("ANE") into account, we lose up to two years, at most, which take us to the beginning of 2025. This is a confirmation of my other calculations in this book.

So, this was our rough thought experiment. In reality, the global net oil exports volume is squeezed by **three <u>exponen-</u>**

tials; exponentially declining production, exponentially increasing consumption, and exponentially falling EROEI. The decline of oil exports goes really, really fast in the end. So fast that it is difficult to fathom. Like all exponential curves. But, mind that the rise in consumption of **at least** 2 % every year, **has in fact happened since 2005**, and that the fall of EROEI in fact **has also happened since 2005**, and has in reality been falling by at least 12,5 % since (has fallen from perhaps 20:1 to perhaps 8:1.) The only factor of these three that has not gotten worse since 2005, is the decline of oil production, this decline has started only in 2019 (2016 for conventional oil). Those years that oil production didn't decline, can, in our rough thought experiment, make up for us not accounting for the exponential nature of all these three factors. Mind also that of all these three factors, oil production decline is the one which will get most precipitous, when it begins to accelerate, which also can make up for the faults in our thought experiment.

Then you maybe better understand the statement in this very important and **fateful** article, that I haven't shared with you before:

"Saudi Arabia May Run Out Of Oil To Export By 2030" on "The Business insider" (originally on "The Telegraph") on September 6, 2012, by Emily Gosden. The statement came originally from research by the bank Citigroup. Many news outlets wrote about the issue back in September 2012. It was big news. Unfortunately we are even more **energy blind** today as back then, although we are reaching the Energy Cliff at a fast pace. We are sleepwalking over the Cliff, it seems.

(1) The comment is the second comment below the blogpost:

"drtimmorganon June 17, 2023 at 1:36 pm said:

I remember back in about 2003 being asked by one of my bosses whether peak oil would really happen ("yes"), and when ("about 2018"). We're never going to "use up" all the oil in the ground, but a lot of what remains isn't cost-effective.

Fracking, as an example, has enabled the recovery of oil which would otherwise have been left in the ground. But it can't change the fundamental physics, which is why fracking has never been really profitable.

With 2019 as the baseline, I'm projecting oil supply lower by 18% in 2030, and 33% by 2040. This is a compound annual decline rate of about 2%, which sounds gradual, but mounts up over time. I may be revising these numbers later this month when we get definitive data for 2022."

More nuances to the global net oil export story: confusing numbers.

The oil world is much more complex than I thought. Also the world of oil exports. There is a big confusion as to the global numbers and to the global volumes of oil.

In the article "How Egypt spells oil spike" by Colin Barr on February 1, 2011, on "www.fortune.com", oil geologist Jeffrey J. Brown, who is one of the few who have really done the math on oil exports, said that in 2005, when the oil exports peaked, we had **41 million barrels per day** of global net oil exports. This is another number than the 46 mbd that he gave in this interview from 2015, on which I built the whole argument in the first part of this book. In the same part I built on Jeffrey Brown's numbers about the volume of oil exports we had in 2021, which was 30 mbd, see this article about it from 2021.

Well, in the first article above from 2011 by Barr, Jeffrey Brown projected that we would have only 27 mbd of oil exports in 2015. This number is much smaller than he later, in 2021, said we could have in that year. And it does not conform to the calculations I have made below. It's too radical.

How could this be? How could Brown later, in 2015 and 2021 come up with so different numbers (the 46 mbd and 30 mbd figures)? You see, the confusion is great. Maybe he left out some kind of oil from the calculations, maybe the unconventional oil, in his 2011 numbers. But he does not mention that. This is what makes the confusion great.

This article from 2014 by Ron Patterson doesn't make it easier to calculate *. According to his graphs there, global net oil exports peaked **in 2007**, not in 2005, at about 43,3 mbd and stood, in 2013, 2,47 mbd below that point, i.e. at about 40,83

mbd. Patterson accounts for crude + condensate, **which contains a lot of unconventional oil** (it only discounts “natural gas liquids”, “refinery gains” and biofuels)**.** So the volume of **conventional** crude exports should have been even lower in 2007 than what Patterson's numbers show, if Patterson is right.

As a side note, in the comments section to Patterson's article above, Jeffrey Brown has this very important comment:

"Given an (inevitable) ongoing decline in production in a net oil exporting country, unless they cut their internal oil consumption at the same rate as, or at a faster rate than, the rate of decline in production, the resulting net export decline rate will exceed the production decline rate and the net export decline rate will accelerate with time, on a year over year basis. It’s a mathematical certainty.

Given an (inevitable) ongoing decline in Global Net Exports of oil (GNE), unless the Chindia region CUTS their consumption of GNE at the same rate as the rate of decline in GNE, or at a faster rate, the resulting rate of decline in ANE (the volume of net exports available to importers other than China and India) will exceed the GNE decline rate and the ANE decline rate will accelerate with time, on a year over year basis. It’s a mathematical certainty."

But that's for another blogpost. Let us, as a thought experiment, calculate the end of global net oil exports according to Brown's 2011 numbers above, which are the lowest I have met (they could in fact be the "only conventional oil exports" calculation here, because 5 mbd less than 46 mbd is 10,9% less, and the volume of overall conventional oil production is about 10 mbd less than crude+condensate, which the 46 mbd perhaps could imply, and 10 mbd less than ~84 mbd [this was the volume of

crude+condensate at its peak] is 11,9 % less). Let's then assume here the same decline rates of global net oil exports as I have done in the first section of this book.

Then I do the following calculations:

1) From 2005 to 2013 the decline should be 3 mbd (see part 2 in the first section of this book), so it goes from 41 to 38 in eight years.

2) Then there should be a decline of 13 mbd between 2013 and 2021, like in my previous calculations. A quadrupling of the decline rate in eight more years. So it goes from 38 in 2013 to 25 in 2021. So we have 25 mbd instead of 30 mbd in 2021. Could it be 30 mbd after all? I don't think so, I don't think it fits very well with the projection of 27 mbd in 2015, that Brown made in the same article where he used this 41 mbd figure. But I concede that in the first section of this book, part 8, I calculated that Brown must have meant only conventional oil with his 30 mbd figure for 2021. But this is an impenetrable jungle. I cannot get all the numbers to fit each other. The confusion is, as I said, big. But I don't think it disturbs very much my thesis that the end of global net oil exports will come in 2027.

3) If one tries to quadruple (in line with the trend in 1] and 2]) the average decline rate per year between 2013 and 2021, i.e. quadruple 1,6 mbd per year, then one gets a decline rate of on average 6,4 mbd per year for the eight year period 2021 to 2029, which is difficult to apply to the numbers (see my calculations below), so high it is. And then one doesn't even reach 2032, but the volume of net oil exports goes down to zero already **in just below 4 years**, i.e. already in November-December 2024 at the earliest (3,9 X 6,4 = ~25). The date should be adjusted to about 2027 at the earliest, because the decline rate

during the period 2021-2029 is not as fast in the beginning as it is in the end, it accelerates with time, and goes really fast in the end, as all accelerated rate of decline curves do. So I estimate that the first year after 2021 the yearly decline is about 3 mbd a year, and accelerates to 6,8 mbd a year in 2027, thus (observe that this is an average decline rate of 4-5 mbd a year, not 6,4 mbd):

2021 = 25 mbd. It declines by 3 mbd to 22 mbd.

2022 = 22 mbd. It declines by 3,3 mbd to 19,7 mbd.

2023 = 19,7 mbd. It declines by 3,7 mbd to 16 mbd.

2024 = 16 mbd. It declines by 4,2 mbd to 11,8 mbd.

2025 = 11,8 mbd. It declines by 4,8 mbd to 7,0 mbd.

2026 = 7,0 mbd. It declines by 5,5 to 1,5 mbd.

2027 = 1,5 mbd. It declines by 6,8 to zero.

As you see, the decline rate really accelerates in the end, very abruptly.

So, 2027, again (in the beginning of this year), is probably the year of the end of global net oil exports that we get here, if we begin with the 41 mbd figure at the peak of oil exports 2005. **It gives us about one year less time, relative to my previous calculations**. It's reasonable, because if we had only 41 mbd in 2005, then 5 mbd is 10,9 % of 46 mbd (Brown's 2015 figure for the peak of oil exports), and 10,9 % of the time from 2021 to 2030 is about one year.

The "2027-scenario", though, doesn’t take into account my "ten critical factors" in part 1 of the first section of this book, factors

which could make the decline even steeper and more abrupt. And if we then calculate the "available net exports" ("ANE", global net oil exports minus "Chindia's", China's and India's net imports), and try to determine the date when China and India consume all oil exports on the export market, **we arrive at an even earlier date than 2027**. Because ANE was not accounted for in my calculations above, in the "2027-scenario". Maybe we then arrive at the beginning of 2026 or at the beginning of 2025.

I would anyway say, that if Brown's "41 mbd at the peak of oil exports 2005" assumption is right, then it confirms even more my thesis that 2027 at the latest is the end of "available global net oil exports", and that Brown's 2030-2032 date is in fact a best-case scenario for the end of global net oil exports.

The aim of this chapter was to show that the "46 mbd at the peak of oil exports 2005" is just one of many estimates, and is the highest estimate I have found, being thus a best-case-scenario.

* Patterson has an important comment to his article:

1. ”RON PATTERSON
07/29/2014 at 11:36 am

The average decline rate of fields that have started to decline is about 8%.

Well not exactly. From Saudi Arabia eight years ago:
Saudi Arabia’s Strategic Energy Initiative: Safeguarding Against Supply Disruptions

• *Without "maintain potential" drilling to make up for production, Saudi oil fields would have a natural decline rate of a hypothetical 8%. As Saudi Aramco has an extensive drilling program with a budget running in the billions of dollars, this decline is mitigated to a number close to 2%.*

The natural decline rate for fields in decline is indeed 8%. But that decline rate can be greatly reduced by massive infill drilling. Virtually every giant and super giant field in the world has, over the past decade, experienced massive infill drilling with horizontal wells creaming the top of the reservoir. This has massively reduced the decline rate in Saudi Arabia, Russia and just about everyone else with old giant declining fields.

Of course a slow decline rate means a massive increase in the decline rate once water hits those horizontal wells near the top of the reservoir. That will cause a shark fin decline curve that will be way above the natural 8%."

A short summary of my global net oil export calculations in previous blogposts

From 2011 to 2021 global net oil exports declined from 43,7 to 30 mbd (see the article"Global oil exports in decline since since 2006. What will importing nations do?" by Kurt Cobb on the site "Resilience.org", 23.9.2012), despite the fact that conventional oil production was pretty much flat, on a bumpy plateau, from 2011 to about 2019. **Just think then how fast the decline will be when the real decline in conventional oil production takes off, or, the unthinkable: begins to fall off a cliff.**

The decline from 2011 to 2021 (13,7 mbd in 10 years, 1,37 mbd per year) was about a little over a tripling of the rate of decline from 2005 to 2011, which was 2,3 mbd in 6 years (according to Kobb's article), a decline of about 0,4 mbd per year.

One would then assume that the decline rate from 2021 to 2030 would be **at least** a tripling of the rate of decline between 2011 and 2021, i.e. 4,12 mbd per year, which is, in 9 years (4,12 X 9), 37,08 mbd. Let's add one mbd on top of that, because the rate was a little more than a tripling. So we get 38 mbd. This means that global net oil exports will end a couple of years before 2030. This is only if we think more linearly. If the rate of decline accelerates abruptly, one could easily imagine an even more abrupt stop. **It's the last doubling, in an exponentially rising curve, that catches us with surprise.**

But let's, for convenience, take that 38 number. So it is 8 more than 30 mbd, which was the oil exports left after 2021. 8 is ~26,7 % of 30. So 26,7 % of the time before 2030, global net oil exports end, if we focus on the time between 2021 and

2030. What is 26,7 % of 9 years? Answer: 2,4. So we have to subtract 2,4 years from the year 2030, in order to get to the point where oil exports end. Then we are in the middle of 2027. **This pretty much confirms all my previous calculations.**

Remember that I have calculated this without thinking about "available net oil exports" ("ANE"), which, if one accounts for them, may make the end of the oil export market come even sooner, i.e. there will come a time when China and India consume all the oil exports, which makes the end of oil exports come sooner. Maybe in 2026, or, at worst, in 2025. This confirms my calculations in part 2 in the first section of this book.

And neither have I taken into account my "ten critical factors", referred to in my book. They could together make the end of oil exports very, very abrupt.

The end of "Available Net Exports" ("ANE") in the oil export market.

(This blogpost is for those who have followed my oil export blogposts. It can very well be read to the exceedingly beautiful music of this song: [SZA - Good Days [slowed + reverb]])

"After 2005 of course, we have seen a significant decline in ANE, falling from 40 mbpd in 2005 to 35 mbpd in 2011." (1)

(Jeffrey J. Brown in the article "Commentary: The export capacity index" on "Resilience.org", on February 18, 2013)

In this book I calculated mainly the overall decline of global net oil exports and global net diesel exports. What I didn't do, was to show how I calculated the "available net exports" ("ANE"). Now I will do such a calculation. This "ANE" is namely declining much faster than the overall global net oil exports (what Brown calls "GNE", "Global Net Exports"). Do you remember that according to Brown, GNE declined by only 3 mbd in 8 years, from 2005 to 2013, i.e. from 46 mbd to 43 mbd? In ANE we have a decline of 5 mbd in 6 years, from 2005 to 2011. This is more than a doubling of the decline rate of GNE. This means that in 8 years ANE declines by 8 mbd, in the period from 2005 to 2013.

In the oil export literature on the internet I have found two ways of calculating the decline of oil exports in our world, both operating with about eight year periods since the peak of global net oil exports in 2005, where the average decline rate of the oil exports either triple or quadruple in every eight year period. I'm not sure which of these is the right rate of decline (so much is uncertain in the oil export mathematics), so I will calculate with the smallest number (a tripling rate), because I always try

to be conservative in my calculations. I will also add a calculation where I only calculate with a doubling of the rate of decline in every eight year period:

Scenario 1, the "tripling scenario": Assuming a tripling of the decline rate in every eight year period since 2005:

1) From 2005 to 2011: a decline of 5 mbd, from 40 mbd to 35 mbd. That is 5 mbd in 6 years. This is an average decline rate of about **0,85 mbd** every year. If we calculate with eight year periods, then we have to add two more years with 0,85 mbd decline, which takes us to 2013 with 33,3 mbd (2 X 0,85 = 1,7, 35 - 1,7 = 33,3 mbd). From 2005 to 2013 there is thus a decline of 6,7 mbd.

2) From 2013 to 2021: a yearly average decline of 3 X 0,85 = **2,55 mbd**. 8 years X 2,55 mbd = 20,4 mbd. 33,3 mbd minus 20,4 is 12,9 mbd.

3) From 2021 to 2029: a yearly average decline of 3 X 2,55 mbd = **7,65 mbd**. How many years with this average decline will our calculation give us? We have only 12,9 mbd to consume since 2021. Answer: Less than two. It brings us to the year 2023. But we have to remember that the decline goes slowly in the beginning, and accelerates towards the end. So if we assume that the decline is 3,5 mbd in the beginning, and rises towards 5-6 in the end, then we can construct the following model:

2022: 12,9 - 3,5 = 9,4.

2023: 9,4 - 4 = 5,4

2024: 5,4 - 4,6 = 0,8

2025: 0,8 - 5,4 = 0

So we reach zero already in the beginning of 2025 in "ANE" in this scenario, which is in accordance with my most radical previous ANE guesses in my previous calculations, where we reach zero in oil GNE (Global net exports) in 2027, and then I have supposed that a couple of years before that we will reach zero in ANE.

Scenario 2, the "doubling scenario": Assuming a doubling of the decline rate in every eight year period since 2005:

1) From 2005 to 2011: a decline of 5 mbd, from 40 mbd to 35 mbd. That is 5 mbd in 6 years. This is an average decline rate of about **0,85 mbd** every year. If we calculate with eight year periods, then we have to add two more years with 0,85 mbd decline, which take us to 2013 with 33,3 mbd (2 X 0,85 = 1,7, 35 - 1,7 = 33,3 mbd). From 2005 to 2013 there is thus a decline of 6,7 mbd.

2) From 2013 to 2021: a yearly average decline of 2 X 0,85 = **1,7 mbd**. 8 years X 1,7 mbd = 13,6 mbd. 33,3 mbd minus 13,6 is 19,7 mbd.

3) From 2021 to 2029: a yearly average decline of 2 X 1,7 mbd = **3,4 mbd**. How many years with this average decline will our calculation give us? We have only 19,7 mbd to consume since 2021. Answer: only 5,7 years. It brings us to the year 2026. But we have to remember that the decline goes slowly in the beginning, and accelerates towards the end. So if we assume that the decline is 2,5 mbd in the beginning, and rises towards 6,8 in the end (because the end of an accelerated rate of decline curve is very abrupt, goes very fast in the end), then we can construct the following model:

2022: 19,7 - 2,5 = 17,2

2023: 17,2 - 3 = 14,2

2024: 14,2 - 3,6 = 10,6

2025: 10,6 - 4,3 = 6,3

2026: 6,3 - 5,3 = 0,9

2027: 0,9 - 6,8 = 0

So we reach zero already in the beginning of 2027 in "ANE" in this second scenario, which is not far from my previous “ANE” calculations, where we reach zero in "ANE oil” in 2025.

<u>Conclusion:</u> A doubling of the decline rate in every eight year period, instead of a tripling, <u>will only give us at most two more years of global net oil exports</u>. The 2030 figure that Jeffrey J. Brown gave us as the end of "ANE", is thus a best-case scenario.

(1) Comment by L.L.: In this article in “Energy Bulletin” on April 12, 2012, Brown has an even more radical estimate, he says there: *"While the US has shown a small increase in crude oil production, up from the pre-hurricane rate of 5.4 mbpd in 2004 to 5.7 mbpd in 2011, a net increase of 0.3 mbpd, this is virtually a rounding error in the context of the multimillion barrel per day declines that we have seen in GNE, especially the ongoing decline in the volume of GNE available to importers other than China and India, **which dropped from 40 mbpd in 2005 to 35 mbpd in 2010**."*

So if this is true, that we lost 5 mbd in **five years** instead of in 6 years during the period 2005-2010, this means that the decline of ANE during the years 2005-2027 goes even faster. If it

is true, we might lose some months, maybe half a year, or even a year. I don't calculate a scenario with these data, I only conclude with saying that this makes it even surer that we lose ANE in 2027 **at the latest**.

Or no, I will do a calculation anyway, for safety's sake. I then construct two scenarios, one with a tripling of the decline rate in every eight years, and one with a doubling of the decline rate in eight years, as I did in the calculations above.

Scenario 1B, the "tripling B scenario": Assuming a tripling of the decline rate in every eight year period since 2005:

1) From 2005 to 2010: a decline of 5 mbd, from 40 mbd to 35 mbd. That is 5 mbd in 5 years. This is an average decline rate of about **1 mbd every year**. If we calculate with eight year periods, then we have to add three more years with 1 mbd decline, which take us to 2013 with 32 mbd (3 X 1 = 3. Then 35 - 3 = 32 mbd). From 2005 to 2013 there is thus a decline of 8 mbd.

2) From 2013 to 2021: a yearly average decline of 3 X 1 = **3 mbd**. 8 years X 3 mbd = 24 mbd. 32 mbd minus 24 is 8 mbd. We have 8 mbd left in 2021.

3) From 2021 to 2029: a yearly average decline of 3 X 3 mbd = 9 **mbd**. How many years with this average decline will our calculation give us? We have only 8 mbd to consume since 2021. Answer: Less than one. It brings us to the year 2022. But we have to remember that the decline goes slowly in the beginning, and accelerates towards the end. So if we assume that the decline is 3,5 mbd in the beginning, and rises towards 5-6 in the end, then we can construct the following model:

2022: 8 - 3,5 = 4,5.

2023: 4,5 - 4 = 0,5

2024: 0,5 - 5 = 0

So we reach zero already in the beginning of 2024 in "ANE" in this scenario, which is more radical than my most radical previous ANE guesses in my previous calculations, where we reach zero in oil GNE (Global net exports) in 2027, and then I have supposed that at most a couple of years before that we will reach zero in ANE, i.e. in 2025.

Scenario 2B, the "doubling B scenario": Assuming a doubling of the decline rate in every eight year period since 2005:

1) From 2005 to 2010: a decline of 5 mbd, from 40 mbd to 35 mbd. That is 5 mbd in 5 years. This is an average decline rate of about **1 mbd** every year. If we calculate with eight year periods, then we have to add three more years with 1 mbd decline, which takes us to 2013 with 32 mbd (3 X 1 = 3, then 35 - 3 = 32 mbd). From 2005 to 2013 there is thus a decline of 8 mbd.

2) From 2013 to 2021: a yearly average decline of 2 X 1 = **2 mbd**. 8 years X 2 mbd = 16 mbd. 32 mbd minus 16 is 16 mbd. We have thus 16 mbd left in 2021.

3) From 2021 to 2029: a yearly average decline of 2 X 2 mbd = **4 mbd**. How many years with this average decline will our calculation give us? We have only 16 mbd to consume since 2021. Answer: only 4 years. It brings us to the year 2025. But we have to remember that the decline goes slowly in the beginning, and accelerates towards the end. So if we assume that the decline is 2,5 mbd in the beginning, and rises towards 7 in the end (because the end of an accelerated rate of decline curve is

very abrupt, goes very fast in the end), then we can construct the following model:

2022: 16 - 2,5 = 13,5

2023: 13,5 - 3,5 = 10

2024: 10 - 5 = 5

2025: 5 - 7 = 0

So we reach zero already in the beginning of 2025 in "ANE" in this second scenario, which confirms my previous ANE calculation in scenario 1, where we also reach zero in "ANE" oil in the beginning of 2025.

Conclusion: Calculating with Brown's 2012 figures above, instead of his 2013 figures, will give us one to two years less of oil exports relative to the first "tripling scenario", and two years less oil exports relative to the first "doubling scenario".

End note to all calculations in this chapter: Realizing that ANE has declined by over twice the rate of GNE in the beginning after 2005, and that it also continues to decline faster than GNE, it is reasonable to assume that the end of ANE will come up to two years before the end of GNE, and if we assume that GNE, according to most of my calculations in this book, will end in 2027 at the latest, then the end of ANE will likely come in 2025-2026. And thinking that ANE is what really counts, it is what will decide the future of all oil importing countries beside China and India, this date, 2025-2026 is what we should really care about. This date feels too radical, and I don't believe in my own calculated conclusions, something can be wrong, so I stick with the 2027 date, and think that the end of ANE will come then, **at the latest**.

Addition 27.7.2023: It is interesting to find the results of the calculations in this blogpost confirmed by Jeffrey J. Brown (called "westexas" in this post) himself, in this part of this comment to the article "Trends in World Oil Supply/Consumption and Net Exports/Imports", posted by Rune Likvern on September 28, 2010 on “The Oil Drum: Europe”:

"And then there is the question of who wins the bidding war for declining net oil exports. Chindia's combined net oil imports as a percentage of total global net oil exports increased from about 11% in 2005 to 17% in 2009. At this (2005 to 2009) rate of increase, the ratio of Chindia's combined net oil imports to global net oil exports* would approach 100% around 2026, 16 years from now. As they say, "Somethings gotta give." I suspect that "Something" will be that developed OECD countries, especially, the US, will continue to be on the losing end of the bidding war for global net oil exports."*

In the article "Commentary: Is it only a question of when the US once again becomes a net oil exporter?", by Jeffrey J. Brown, on "Resilience.com", on June 10, 2013, Brown writes:

"At the 2005 to 2012 rate of decline in the ratio of GNE to China and India’s combined net oil imports, in only 17 years (in 2030, my remark) *China and India alone would theoretically consume 100% of global net exports of oil."*

Observe that the decline in the ratio of GNE to Chindia's combined net oil imports **is accelerating**, not linear, as Browns second calculation above wrongly assumes. This speaks for Brown's "2026-scenario" above, not for the "2030-scenario".

Calculating the end of global net oil exports (GNE) with Euan Mearns' data

"An oil export model has been developed based on BP Statistical Review 2016 oil production and oil consumption data. The model shows that global oil exports peaked in 2006 at 37.87 Mbpd. They have since fallen very slowly to stand at 37.07 Mbpd in 2015, the last year for which we have data."

(Euan Mearns in the blogpost "Peak Oil Exports", posted on March 6, 2017 on the blog Energy Matters)

This is a very different set of data than Jeffrey J. Brown's (who estimated that we hit the peak of global net oil exports in 2005, at 46 mbd), and maybe not as trustworthy, because Mearns is not an oil geologist. But I will, for the sake of a thought experiment, calculate the end of "GNE" ("Global Net Exports", i.e. the overall global net exports) based on these data, and fill in with Brown's data where Mearns doesn't provide data.

Now to the calculations of GNE:

So the decline was, in the nine years from 2006 to 2015, as little as 0,8 mbd (million barrels per day). That's an average decline rate of 0,09 mbd every year, an extremely slow one.

According to Brown we had 30 mbd of GNE in 2021 (here I have to fill in with Brown's data, because Mearns doesn't give his data for 2021). 37,07 - 30 is 7,07. So we lost 7,07 mbd in the six year period from 2015 to 2021. This is an average decline of 1,18 every year.

So how many times faster is a 1,18 mbd yearly decline rate than a 0,09 mbd yearly decline? Answer: 13,1 times faster. So, to be able to calculate the decline rate for the nine year period from 2021 to 2030 (if we want to have an accelerated rate of decline) we have to multiply 1,18 with 13,1. Then we get 15,46. This is what an accelerated rate of decline looks like in this case. So the decline rate between 2021 and 2030 is a staggering 15,46 mbd every year, on average. How many years does it give us? Answer: We have only 30 mbd to begin with in 2021, so it gives us almost two years. Then we are in 2023. But the decline goes much much slower in the beginning, and very fast in the end, so we could postpone this date according to the following model, where we begin with a slower decline of 5 mbd, and end with a very fast decline of 15 mbd, to try to make this decline a little bit more realistic:

2022: 30 mbd - 5 mbd is 25 mbd.

2023: 25 mbd - 7 mbd is 18 mbd.

2024: 18 mbd - 10 mbd is 8 mbd.

2025: 8 mbd - 15 mbd is 0.

And this is not even the end of "ANE" ("available net exports"), which comes at most a couple of years before, in the middle of 2023! Something is wrong with Mearns' data. I don't trust them.

Conclusion: The data that Euan Mearns provides, makes the end of "GNE" and "ANE" come a couple of years earlier than it does with the data set Jeffrey J. Brown provides. And it is too early, so something must be wrong with his data, that he got from BP Statistical Review 2016.

Will Sweden be among the last or among the first to lose its oil imports?

Will Sweden be among the last or among the first to lose its oil imports? How strong is the purchasing power of Sweden to buy oil in the future harsh competition for the last oil exports?

What determines the purchasing power? Maybe the amount of debt is an important thing. Is Sweden heavily indebted? Yes, in the private sector. The Swedish state is not so heavily indebted. But household debt in Sweden was among the highest in Europe in 2014 (see this article). Here is newer information, from 2020, it accounts for the whole world, also on this list Sweden is ranked high, it came seventh.

Which are the least indebted rich countries in the world? They could be among the last to be able to import oil.

This chart may be useful: "The 20 countries with the lowest national debt in 2022 in relation to gross domestic product".

This list is also useful: "National Debt by Country / Countries with the Highest National Debt 2023".

There we find oil importing rich countries like Chile, Hungary, Estonia and Bulgaria, which all have little national debt. They should be able to import oil longer than Sweden. Neither we hear about any economic collapse in these countries.

And what about household debt?

The list in this article may be useful: "Every Country in the World Ranked by Average Personal Debt", by Ezra Cabrera, on April 4, 2022.

There we find rich western countries like Latvia, Lithuania, Hungary and Slovenia which all have very little personal debt. They should perhaps be able to import oil longer than Sweden. Neither we hear about any economic collapse in these countries.

But Sweden is, despite its high household indebtedness, a very rich country, among the richest in the world, and has great natural resources like its many big forests, which could make it competitive anyway. See this article: "Why Sweden beats other countries at just about everything" on Jan 30, 2017, about the competitiveness of Sweden in 2017.

One thing that could make Sweden less competitive is its relatively high environmental goals. Strict environmental policy is bad for GDP (although morally right).

But "the race for what's left" (the title of professor Michael Klare's book from 2012 [see who he is here], hasn't this race intensified since then?), the race for the last oil exports, will be interesting, to say the least.

The decline of global net oil exports is going fast right now. Look at Saudi Arabia. And something about unbelievable news.

See this recent article: "Saudi oil exports down 40% in May y/y - statistics agency", by Reuters, Dubai, on July 25, 2023.

The article says:

"Saudi oil exports fell almost 40 per cent in May from the same period a year ago, latest government data released on Tuesday showed, weighing on overall total exports, amid an extension of voluntary production cuts and lower oil prices.
The value of oil exports declined to 72 billion riyals ($19.20 billion) in May from 115.5 billion riyals last year, the General Authority for Statistics said, down 37.7 per cent, with the share of oil exports in total exports down to 74.1 per cent from 80.8 per cent in May 2022."

I couldn't almost believe it to be true. Reuters is a serious news outlet. But this is somewhat in line with my calculations in my oil export book.

This rapid decline can only partly be explained by the fall of the oil price from 120 dollar per barrel in June 2022, to the 67-68 dollar per barrel oil price in May 2023, as you can see in this chart. The other part, which is more important, is the many big oil cuts that Saudi Arabia has done since the fall of 2022 (see this article, since then the same has happened many times), which means a lot less oil exports.

This should be big news in all newspapers in the world, but it isn't (google for yourself, and you'll see. Only very specialized news outlets, like oilprice.com, see here, write about it. Maybe it will be big news soon. Let's hope it is more interesting than

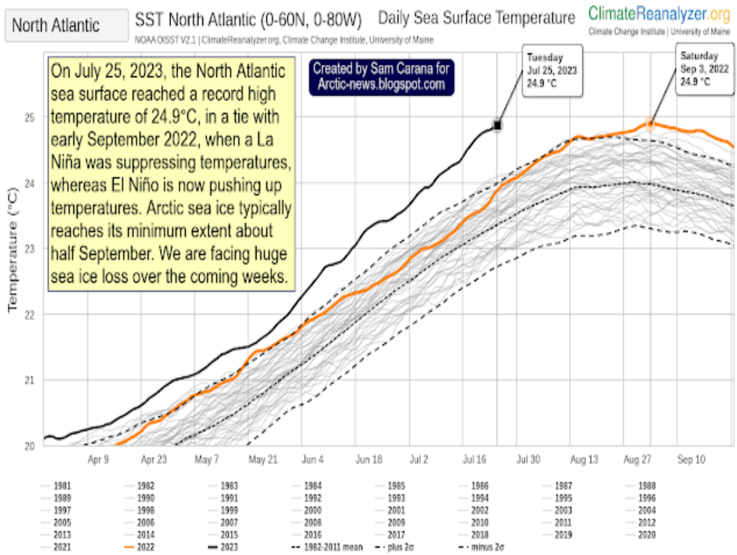
the latest football games). We don't live in a free world where truth is honored. And do you think that the current decline of Saudi oil exports is attributed to the overall trend of naturally declining oil exports, of depletion, not political issues, the depletion which has a long history? Do you think anyone is writing about the big picture here? Nope. The Saudis are blaming it on other things. Of course. They have to, so they can keep investors attracted to their Ponzi Scheme. The whole world economy is a Ponzi Scheme.

Mind that Saudi Arabia is the foremost oil exporter of the world, with the biggest volume of oil exports of all countries.

This decline of oil exports is a trend in the world, which has been going on for a long time*. The world's second biggest oil exporter, Russia, is also in the same process of rapidly declining oil exports. See for example this recent article on www.oilprice.com: "Russian Crude Oil Exports Continue To Plunge", by Tom Kool on Jul 25, 2023, where he says that "**Russia's crude shipments plunged by 311,000 bpd to 2.73 million bpd in the week to July 23."** A decline of 311,000 barrels per day in one week! It's mindboggling.

I read nowadays news that I can hardly believe to be true. Like the news eighteen days ago about the national debt in the US having grown **by 1 trillion dollars** in one month! I wrote about it here. Since those news US national debt has grown by about **260 billion dollars**, **over a quarter trillion dollars**, see for confirmation this debt clock. If it continues to grow at this pace, then the US national debt will have grown by half a trillion dollar in one month after those news came out. Not far from the one trillion, and certainly the one trillion per month figure will be more and more common.

Or what about the news in this graph in the blogpost "Record high North Atlantic sea surface temperature" by Sam Carana on Arctic News on July 27,2023:



Can you believe your own eyes?

Folks, we do not have long time left.

Oh, come Lord Jesus.

* A little dive into the history of Saudi oil export decline: see this article from 2022, this article from 2021, this article from 2020, this article from 2020, this article from 2020, this article from 2019, this article from 2017, this article from 2017, this article from 2012, this article from 2011, this article from 2007.

Do you see the trend? And if the decline in oil exports is this fast in the mightiest oil exporting country in the world, with the lowest EROEI on its oil (it means with the cheapest oil to produce) in the world, and the mightiest reserves, how is it then with weaker oil exporting nations?

Something on the accelerated rate of decline in global net oil exports

It's really, really hard and difficult to really **believe** that global net oil exports decline exponentially, i.e. with an accelerated rate of decline, i.e. that it declines faster and faster with time, which I have stated in my book about the end of global net oil exports, here (1). But there is a firm foundation for believing this, that is based, not on speculations, but on mathematics. Independent, professional licensed petroleum geologist (they are good at math, I promise, and then Brown has had as a helper a math genius, Dr. Sam Foucher) Jeffrey J. Brown said in an interview 2015 that **this is a mathematical certainty at high rates of consumption, which is exactly where we are today and where we have been for a long time (2)**. Here is the context of what he said (bold mine) (he reiterates the "it is a mathematical certainty" three times in the interview), observe that the interview was held in September 2015, and Brown was very well aware of the shale oil revolution, which had continued for **five long years** by then (it is not correct, as some peakoilers have done in email contact with me, to dismiss Brown's projections with the notion that he has not accounted for the shale oil revolution in his oil export calculations):

"**Jeffrey Brown:** Well, I started wondering in late 2005 what happens to oil exports from an exporting country, given a production decline and rising consumption. And, so I just constructed a simple little model. I assumed a production of about two million barrels a day or so at peak, consumption of one, and assumed production falls about 5% per year, (basically what the North Sea did), and assumed consumption increases to 2.5% per year. What the model showed was that net exports would go to zero in only nine years, even though a roughly modest production decline. So, the easy way to state it is: giv-

ing an ongoing, inevitable decline in production, unless an exporting country cuts their domestic oil consumption at the same rate as the rate of decline in production, or at a faster rate, **it's a mathematical certainty** that the net export decline rate—what they actually ship out to consumers—will exceed the rate of decline in production. And, furthermore, it accelerates.

So, you look at exponential declines in oil production and hyperbolic—hyperbolic just means that the decline rate slows with time. Well, this is an accelerating decline rate. So, it'd start out like at 5% and then 10% and then 15% and 25%. Then if you further look at actual case histories, I summed the production consumption and net exports from six exporting countries that hit or approached zero net exports from 1980 to 2010, excluding China. I excluded China because they became a net importer prior to production peak, because their consumption grew so fast. But, in any case, the six countries basically showed exactly what the model predicted, and after a fairly modest production decline, they hit combined zero net exports in only 12 years once their net exports peaked."

And further down, he says:

"**Jeffrey Brown:** Yeah, based on the 2005 to 2013, it'd be 55 years. So it'll be the year 2060. But, the key point of the depletion is it's front-end loaded, so roughly, a rough rule of thumb is about one-third of the cumulative net exports are shipped—I'm sorry, about one-half are shipped one-third of the way into the decline period. So, taking 30 years to hit zero, by the ten-year mark, you have already consumed half of cumulative net exports. Now, when you extrapolate that decline ratio out based on Saudi data for 2014, it suggests that they're already approaching the 50% depletion mark. I suspect that Saudi Arabia may have already shipped close to half of all the cumulative net exports of oil that they will ever net export.

Chris Martenson: Half.

Jeffrey Brown: They're already half-depleted.

Chris Martenson: And, so that depletion being front-loaded like that, it means that we're depleting a little bit more rapidly on the front end of this than the back end on a percentage basis?

Jeffrey Brown: Yeah, and not only that, it's an accelerating rate of depletion. At high rates of consumption, **it's basically a mathematical certainty**, whether you're talking the total remaining reserves or total remaining exportable reserves. At high rates of consumption, what we're dealing with is an accelerating rate of depletion. So, we're consuming remaining resources at a faster rate."

Then further down the article:

"**Jeffrey Brown**: Well, you can do the same thing, what I call available net exports, which is global net exports less China and India's net imports. That metric fell from 41 million barrels a day in 2005 to 34 million barrels a day in 2013. So 41 to 34, and again, we don't have complete data for 2014 yet, but the pattern, apparently, continued in 2014. And, by all available data suggests it's continuing in 2015.

Now, the math is quite similar. The problem is given an inevitable decline in global net exports, which we have seen since 2005, unless China and India cut their net imports at the same rate as the rate of decline in global net exports, the resulting rate of decline in available net exports to other importing countries—other than China and India—will exceed the rate of decline in global net exports and the rate of decline in available net exports will accelerate.

Now, for example, the observed rate of decline in global net exports was 0.8%, slightly less than 1% per year from 2005 to '13. But, the rate of decline in available net exports was almost 2.3% per year, three times higher than 2005 to '13. So, **it's a mathematical certainty** that the only way that the volume of oil available to importers other than China and India will not

show an accelerating rate of decline is if they cut their net imports at the same rate as the rate of decline in durable net exports or at a faster rate."

End quote.

* * *

In the article "Peak Oil Versus Peak Exports", by Jeffrey J. Brown & Samuel Foucher, PhD, in The Energy Bulletin 18.10.2010, they write: "Given an ongoing production decline in an oil exporting country, based on the ELM (Export Land Model, my remark) we can conclude that unless consumption falls at the same rate as, or at a rate faster than, the production decline rate, the resulting net export decline rate will exceed the production decline rate, and the net export decline rate will accelerate with time."

(1) This means also, as I have stated before, that the collapse of industrial civilization will be exponential, i.e. accelerate with time.

(2) *"In 2022 oil consumption worldwide saw an increase of around three percent* (this is already exponential increase, my remark) *when compared to the previous year. Middle East experienced the largest growth, with a consumption increase of 8.9 percent (observe that the Middle East is the most important oil exporter in the world, my remark). This was followed by South and Central America, where oil consumption in 2022 grew by 6.1 percent in comparison to 2021."* (from this article)

What about the growth in oil consumption in the US 2022? This article states: "*In 2022, oil consumption in the United States increased by nearly two percent, compared to the previous year. However in 2021 the growth rate was around nine percent and this represented the largest consumption growth during the period in consideration, after oil consump-*

tion experienced a drop in 2020 as a result of the pandemic-enforced mobility restrictions which led to a decline in transportation fuel demand.

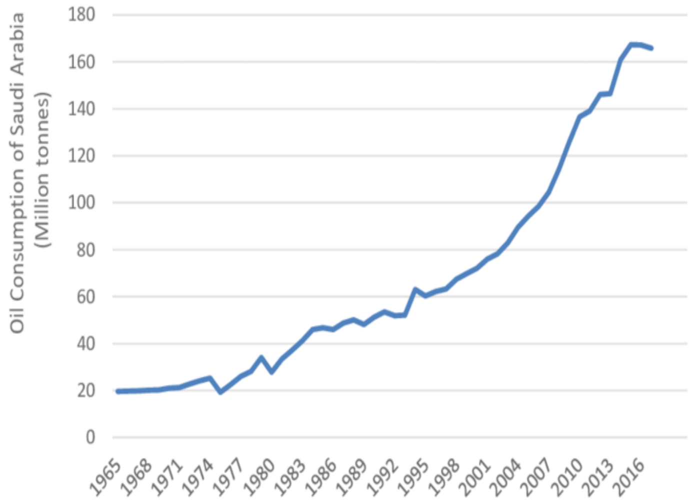
Observe that even if oil consumption grows only with 1 % per year, it is still an exponential rise.

Then read this:

"Based on EIA data, Saudi Arabia showed a +5.7%/year increase in consumption from 2005 to 2006. Figure Four shows a flat line production of 11 mbpd (total liquids) versus a +5.7%/year increase in consumption which would result in Saudi oil exports ceasing in about 2036. The long term net export decline rate (2005 to 2030) would be about -10%/year. As noted above, the year to year net export decline rate would start out slowly and accelerate with time.

For what it's worth, at +5.7%year, the Saudis would be consuming 108 mbpd in 2075, which seems "somewhat" unlikely, since this is about 40% more than current total world liquids production.."

(Jeffrey J. Brown in this article)



(Oil consumption in Saudi Arabia 1965-2017, from this article on www.researchgate.net. There was a downturn during the pandemic around 2020, but the trend upwards has continued since, a rebound has happened)

An English and Swedish article library for studies in global net oil export mathematics

English articles, the newest highest up:

The articles on the blog "Forest Man" that are included in the 2023 e-book "The end of global net oil exports. What really matters in the Peak Oil debate (second edition)", by Lars Larsen

"Saudi Net Oil Exports Have Been Below Their 2005 Level for 16 Years", by Jeffrey Brown, 15 juli 2022
on OilPrice.com's forum

"The Road To Clean Energy Is Messier Than We Thought", by Loren Steffy, UH Energy Scholar, 14.10.2021 on Forbes

"Net Energy Cliff Will Lead to Collapse of Civilization",11.12.2019 by Alice Friedemann on the blog "Energy Skeptic".

"Jeffrey J. Brown: Hurricanes & US Oil Production" Chris Martenson's interview with Jeffrey J. Brown on the blog "Peak Prosperity" 12.9.2017.

"Peak Oil Exports", 6.3.2017 by Euan Mearns on the blog "Energy Matters".

"The collapse of Saudi Arabia is inevitable", by Nafeez Ahmed 5 January 2016 on "Middle East Eye"

From the article: *"Brown and Foucher showed that the inflection point to watch out for is when an oil producer can no longer increase the quantity of oil sales abroad because of the need to meet rising domestic energy demand.*

In 2008, they found that Saudi net oil exports had already begun declining as of 2006. They forecast that this trend would continue.

They were right. From 2005 to 2015, Saudi net exports have experienced an annual decline rate of 1.4 percent, within the range predicted by Brown and Foucher. A report by Citigroup recently predicted that net exports would plummet to zero in the next 15 years."

A PEAK OIL UPDATE AND A QUANTITATIVE ASSESSMENT OF FUTURE NET OIL EXPORTS BY THE TOP FIVE NET OIL...,20.12.2015 by Jeffrey Brown and Samuel Foucher

"Jeffrey Brown: Oil Exporters Will Turn into Importers" on The Strategist.media 15.9.2015

"Jeffrey Brown: To Understand The Oil Story, You Need To Understand Exports" on www.resilience.org on September 15, 2015

"Global oil risks in the early 21st century, Energy Policy 2011" 12.5.2015 by Alice Friedemann on the blog "Energy Skeptic".

"World Crude Oil Exports", 07/29/2014, by Ron Patterson on the blog "Peak Oil Barrel".

UNDERSTANDING THE DECLINE OF GLOBAL OIL EXPORTS, January 2013 by Patrick Brocorens, Université de Mons.

"Peak Oil: Same Pie, Smaller Slice" on the blog "Peak Oil Matters" 21.3.2013

“Commentary: The export capacity index”, by Jeffrey J. Brown, on “Resilience.org”, originally published by ASPO-USA, on February 18, 2013.

"Global oil exports in decline since since 2006. What will importing nations do?" by Kurt Cobb on the site "Resilience.org", 23.9.2012.

"Saudi Arabia May Run Out Of Oil To Export By 2030" on "The Business insider" (originally on "The Telegraph") on September 6, 2012, by Emily Gosden. The statement comes originally from research by the bank Citigroup.

"Guest Post: The Saudi Oil Problem", by TAM HUNT, on JUNE 06, 2012 on www.greentechmedia.com.

"The Export Land Model" on the blog "The American Energy Crisis" 2012

"Crash_Watcher: An Export Land Model Analysis for the USA-Part 1", "Part 2", "Part 3" and "Part 4". (27.1.-13.2.2011)

"Peak Oil Versus Peak Exports, By: Jeffrey J. Brown & Samuel Foucher, PhD" in The Energy Bulletin 18.10.2010 by Aspo-usa

From the article: "*Given an ongoing production decline in an oil exporting country, based on the ELM we can conclude that unless consumption falls at the same rate as, or at a rate faster than, the production decline rate, the resulting net export decline rate will exceed the production decline rate, and the net export decline rate will accelerate with time.*"

"Trends in World Oil Supply/Consumption and Net Exports/Imports", posted by Rune Likvern on September 28, 2010 in The Oil Drum: Europe.

"Analyst Says 'Peak Oil Is Already Here'", by Eli Neusner på ETF.com, 22.8.2008

"Geologist: In Terms of Supply and Demand, the Oil Peak Is Past", 22 augusti 2008, by Eli Neusner on the site "Seeking Alpha".

"World Oil Exports [00] Introduction", posted by Luis de Sousa on June 27, 2008 in The Oil Drum: Europe

"What the Export Land Model Means for Energy Prices" av John Mauldin on "Safe Haven" 20.5.2008

"A quantitative assessment of future net oil exports by the top five net oil exporters" av Jeffrey J. Brown och Samuel Foucher PhD, on the site Resilience.org. 8.1.2008

"Russian Car Sales & Net Oil Exports", on the site "The Oil Drum", by Jeffrey Brown 9.6.2007

"Net Oil Exports Revisited" av Jeffrey J. Brown, on the site Resilience.org. 21.8.2006

"Hubbert Linearization Analysis of the Top Three Net Oil Exporters" on the site "The Oil Drum", by Jeffrey Brown 27.1.2006

"Export land model" on Azimuth project's homepage

"Export Land Model" on Infogalactic.com

(there is also some valuable material for the curious on youtube, mostly a few presentations by Jeffrey J. Brown, and Chris Martenson's two interviews with him. Otherwise there is a deafening silence around these things)

Swedish articles, the newest highest up:

Kommer Sverige bli utan olja att importera 2030? En uppdatering. Publicerad 2022-09-21 på bloggen "Forest Man", av Lars Larsen.

"Exportoljan till Sverige tar slut kring 2030. Kollapsen är total då, i Sverige", 3.11.2019 på bloggen "Forest Man", av Lars Larsen.

"Oljeexporten till Sverige kan ta slut år 2030", av Lars Larsen på bloggen "För Naturens Skull" 1.10.2017.

"Importoljan till Sverige slut 2030?", av Lars Larsen på bloggen "För Naturens Skull" 12.6.2017.

"Jeffrey Brown: 17 år kvar för oljeimporten", av Bengt Randers, den 19 september, 2015, på "ASPO-Sverige-bloggen".

"År 2030 går all oljeexport till Kina och Indien" 25.9.2012 av Martin Saar på "ASPO-Sverige-bloggen".

"Export Land Model" på bloggen "Flute-tankar", 20.6.2012

"Global Oljeexport försvinner bort del 2" 2.5.2012 av Johan Landgren på bloggen "Olja för blåbär".

"Global Oljeexport försvinner bort -del 1", 2012-04-29 av Johan Landgren på bloggen "Olja för blåbär".

"Den svenska oljeimporten", av Lars Wilderäng i maj 2011 på "Cornucopia?-bloggen".

"Export Land Modellen utvecklad", av Bengt Randers på "ASPO-Sverige-bloggen" 5.3.2011

"20 års exportolja kvar", av Lars Wilderäng på "Cornucopia?-bloggen" 2009-12-22

SECTION 3: Updates where I calculate with newer data

This is an interesting graph on oil exports

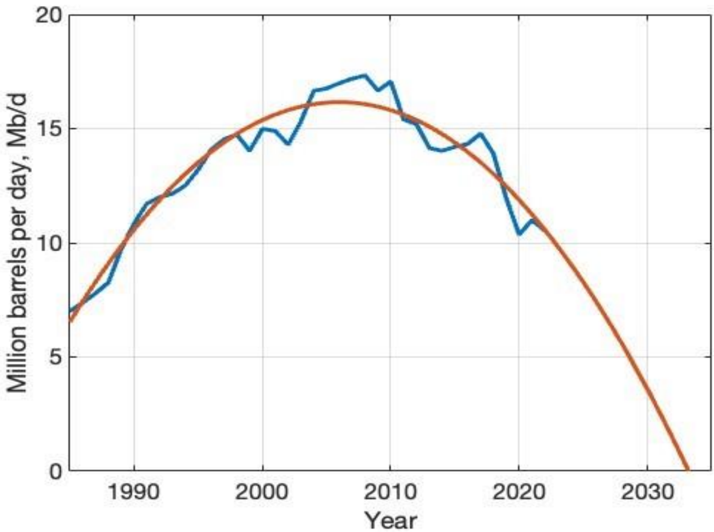
(Published on my blog “I väntan på Jesus” in September 2023)

This graph I found in the comments section on the blog "Peak Oil Barrel", in this comment to this blogpost by Dennis Coyne:

"SEPPO KORPELA

09/24/2023 at 9:04 pm

Here is a parabola for the fit of exporting countries that are in decline. They are done by 2033."



Do you see how steep the decline is from 2017 to 2020? If the pace of decline from 2007 to 2020 is projected upon the future, then the end of oil exports will come well before 2030, and this is what the calculations in my oil export e-book "The end of global net oil exports. What really matters in the Peak

Oil debate" (2023) predicts.

Observe how the trendline from 2023 to 2033 is almost linear, only bending a little. In reality it is a curve that is declining at an accelerated rate, with a very steep decline in the end. Observe that the decline in the beginning is faster than in the end. This is not how oil exports decline. This is one of the reasons why I'm skeptical to this graph.

I'm also a little confused by the numbers in this graph. They seem to show that only about 1/3 of the oil exporting countries are in decline, because the graph shows that in 2021 they had a total of 11 mbd of oil exports, and according to Jeffrey J. Brown the total amount of global oil exports in 2021 was 30 mbd. Is this really true, that only 1/3 of oil exporting countries are in decline? I have my doubts.

Update on oil: The decline of global oil production continues. And some calculations of the present decline in global net oil exports.

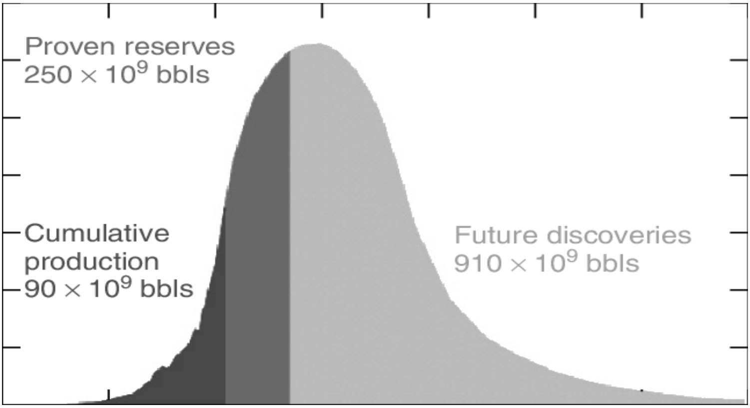
(this blogpost can very well be read to the melodies of Ennio Morricone's extremely beautiful songs "Once upon a time in the west" and "Il figlio e la nostalgia - Il principe del deserto")

*** * * ***

"Preliminary data indicates that global liquids production in September was 0.1 Mb/d less than last month and averaged 100.6 Mb/d."

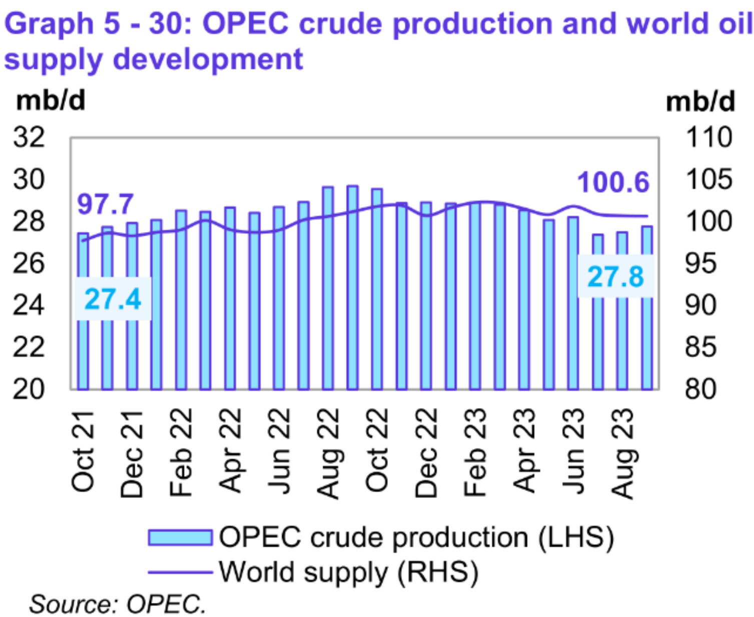
(Dennis Coyne in this recent blogpost on the blog "Peak Oil Barrel")

My comment: So global oil production fell by 100 000 barrels in one month, in August-September 2023. If this decline pace continues, it means 1,2 million barrels per day lost in one year, which is a decline rate of 1,2 % per year. Expect this decline rate to continue, and at last to begin to accelerate in the coming years, as the bell curve does in the "Hubbert curve":



(Graph from this website)

We probably reached the post-pandemic "All Liquids" oil peak in February 2023, at 101,5 mbd (1). See the following graph from Coyne's blogpost above:



(Probably the [Dow Jones Index] reached its all-time peak in December 2021, thirteen months before the post-pandemic peak of global oil production. These two, the stock market and the global oil production, go hand in hand)

Because of a long time of underinvestment in global oil production (see [this recent article]) (this has been a recurrent theme among oil experts for a very long time, at least since 2014-2015 [2], see for example [this article] from 2021), we can be sure that the peak of global oil production has been passed already, and that the trends we see today will continue down the pipeline, yes even accelerate, pick up pace, as time goes by.

The current decline in global net oil exports

If we take a very conservative, linear approach, and project a global oil production decline of 1,2% upon the future, ten, fifteen years from now, then the decline of global net oil exports is **at least the double of that** (3), i.e. a 2,4 % yearly decline, which is 2,4 mbd lost per year (if we fix the amount of decline, because in percentage declines the amount of decline slows down with time, which it doesn't do in our case), which gives us almost 13 years if we begin with 30 mbd of global net oil exports (which is a very conservative estimate. Oil geologist Jeffrey J. Brown said we were at 30 in the end of 2021, but there has been a sharp recovery in oil production since, therefore I think we are still at 30 mbd), which brings us to the year 2036.This year must be the absolute upper limit in our calculations.

If we then go to the decline of "ANE" ("Available Net Exports"), which is "GNE" ("Global Net Exports", the totality of global net oil exports) less the Chindia (China and India) region's combined net oil imports, then the decline goes a lot faster, by **at least** 3 % per year, conservatively estimated. So 3

% of global oil production is ~3 mbd. We have 30 mbd of global net oil exports left, at most (we might in fact be already at 28, 27 or even 26 mbd, which takes us to the end point a bit sooner). **This give us <u>only 10 years</u> of "ANE oil"**. And this brings us to the fall of 2033 (or to 2030-2032 if we are now at 26-28 mbd of global net oil exports, which we very well could be).

This, 2030-2033, is pretty much the best case scenario for the end of global net oil exports, and has been the result of professional licensed oil geologist Jeffrey J. Brown's net oil export calculations. **Observe that I have not taken into account that the real decline of <u>both</u> global oil production and global net oil exports is <u>exponential</u> (it's a mathematical certainty), i.e. have an accelerated rate of decline, goes faster and faster. With that in mind, the end of available global net oil exports (ANE) could very well happen well before 2030, which is the thesis in <u>my book on the end of global net oil exports.</u>** I could certainly have been a bit too radical in my calculations in this book, but I think the core of it is solid and valid. It will be interesting to see how it all will play out, if there is any out there who tracks these things, which I think we should do.

But this, that we lose **at least** 3 mbd of "ANE oil" this year, is staggering, unfathomable. And I would also like to add to my book, that **if I'm wrong in my predictions, I'm then not wrong by a lot of years, not by a decade, maybe only by one year or two, three at most, five to six years if miracles happen, which is not much in the grand scheme of things** (as I said, 2030-2033 is the best case scenario)**.** This should be clear to all who have studied my calculations. Do not <u>shoot the messenger</u> too easily. "The wolf came at last" (read the story I allude to <u>here</u>).

But I confess that when I read the many insignificant news at www.oilprice.com, I have easily gotten the impression that all is well with oil, that we are always at the same levels of global net oil exports, **that there is no decline, not in exports, not in production, and even no Peak Oil**. So badly they report on things. Just too much rubbish and meaningless stuff that lulls people into a false sense of security, burying one's head in details.

(1) *"World oil supply leapt 830 kb/d in February to 101.5 mb/d as the US and Canada rebounded strongly from winter storms and other outages."* (From the website "Oil Market Report - March 2023"). If we were at 100,6 in September this year, it's a decline of 0,9 mbd in 7 months, which translates to an average decline pace of ~1,54 mbd in a year, i.e. 1,54 %. This makes my calculations in this blogpost very conservative, because I calculate with a 1,2 % yearly decline, plus the fact that it is a linear decline, and that the decline amount is fixed. If we use the 1,54 % yearly decline, with a fixed amount of decline every year (otherwise the amount of decline would slightly decrease with time), then the decline of global net oil exports ("GNE") is at at least 3,08 mbd per year in a linear scenario, and the decline of "ANE" (Available Net Exports, which is "GNE" less the China and India region's combined net oil imports) is at least 3,5-3,8 mbd per year in a linear scenario. How many years of "ANE oil" does this give us? Answer: **only 8,5 years** if we begin with 30 mbd of global net oil exports, and 3,5 mbd of "ANE oil" lost every year, linearly. 8,5 years into the future brings us to the spring of 2031. If we begin with 27 mbd of global net oil exports, and with 3,8 mbd of "ANE oil" lost every year, linearly, **we get only 7,1 years**, which brings us to the end of 2030. **Observe that this is a linear approach, and that in reality the decline is exponential, i.e. an accelerated rate of decline (this is a thought experiment).** If we begin with **26** mbd of global net oil exports (GNE) (we could

be at this amount right now, because GNE was at 30 mbd in the fall of 2021 according to Jeffrey J. Brown's calculations [4]), and with 3,8 mbd of "ANE oil" lost every year, linearly, we get **only 6,8 years**, which brings us to the summer of 2029. Add then the exponential factor, and we are easily at 2027 as the end of "ANE oil", which confirms the calculations in **my book on the end of global net oil exports.**

[2] *"There are three ways we can look at the depths of the underinvestment we have witnessed since 2015. Firstly, we can look at the reserve life in the sector. It used to be 50 years and it's now declined to 25 on the back of falling oil reserves and increasing production. This shows the lack of focus in exploration and resource expansion on the back of the push for decarbonization.*

The second way to look at it is to ask ourselves: How much future production have we lost because of all the delays in investment decisions on new oil and gas projects? The answer is 10 million barrels per day of oil, which is the equivalent of Saudi Arabia's daily production and 3 million barrels per day of oil equivalent in liquefied natural gas (LNG), which is more than the equivalent of Qatar's daily production. If we had not kept delaying new investment decisions in oil and gas since 2014, we essentially could have had a new Saudi Arabia and a new Qatar." (From this article on Goldman Sachs on April 28, 2022)

My comment: Those 10+3 million barrels per day (mbd) of oil/oil equivalents mentioned by the article above, this amount the global economy really had needed, if it were not for a cycle of oil supply scarcity/shocks/shortages and oil demand destruction that has plagued the global economy since at least the Great Financial Crisis in 2007-2008. If we had access to those

10+3 mbd today, the global economy would not be in this state of slowdown, or even partly, slow collapse, where it is today. This clearly shows the lack of investment in oil during the last decade, and how poor and wretched we have become, indeed (certainly the will to invest has been present, there is so much money to be made here, but we haven't got the gigantic sums of money and resources we need, because of more and more expensive oil projects, which stems from more and more unconventional oil exploration and oil discovery. We cannot, for example, afford Arctic oil, neither shale oil and tar sands in more and more difficult areas, of poorer and poorer quality.
Yes, **a new Saudi Arabia in oil** would have been needed during the last decade to stay afloat, and a new such is needed in the next decade, at least, to prevent further decline and an accelerated further collapse. We probably won't manage that, but we will have to run faster and faster to stay were we are (the "Red Queen syndrome"), right now, stay in a 1,2% yearly decline.

(3) In this article on "The Energy Bulletin" from 18 October 2010, Jeffrey J. Brown and Dr. Samuel Foucher calculated the decline rate of oil production in the North Sea between 1999 to 2009 to be at 4.8%/year. During the same time oil exports from the area fell by more than double the percentage, yes almost a triple. Brown and Foucher says:

"Note that the net export decline rate exceeded the production decline rate, starting out in double digits, at 12.8%/year, and accelerated to close to 30%/year at the end of the net export decline period."

So my estimate that the decline rate of oil exports is **at least 2,4 % right now**, is conservative and minimalist, at solid ground, I think. This confirms pretty much my calculations in my book, which might, though, have been too radical.

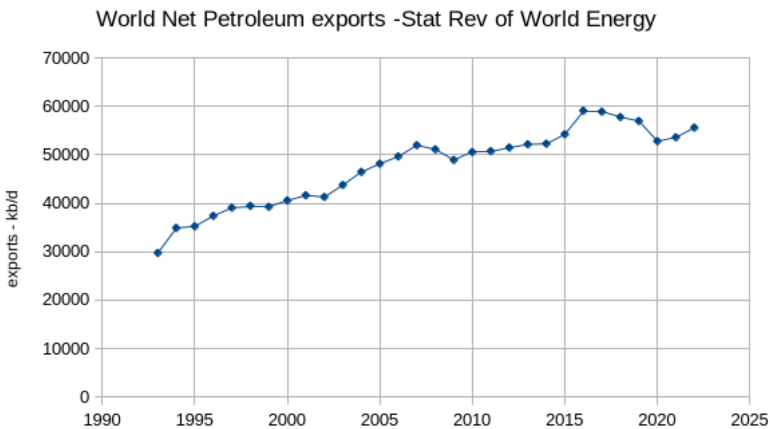
[4] See the article "The Road To Clean Energy Is Messier Than We Thought", by Loren Steffy, UH Energy Scholar, 14.10.2021 on Forbes.

Calculating a scenario for the end of global net oil exports based on the numbers of "Statistical Review of World Energy", EIA and OPEC

(Published on my blog “I väntan på Jesus” in October 2023)

I got some critique from peakoiler Dennis Coyne at the blog "Peak Oil Barrel" for my recent blogpost "Update on oil: The decline of global oil production continues. And some calculations of the present decline in global net oil exports."

His comment with the critique is found here. I quote this graph from it:



1) My answer to Dennis' critique, posted on the "Peak Oil Barrel" blog:

"Dennis: As you may know, I build upon Jeffrey J. Browns calculations. I wonder how his numbers can be so different from the numbers of “Statistical Review of World Energy". According to Brown, global net oil exports peaked in 2005, and was at

about 30 mbd in 2021 (and this is not only ANE oil, i.e. global net oil exports minus China and India's net oil imports). According to your graph above, global net oil exports peaked in 2016-2017, and was at 51-52 mbd in 2020-2021, and then rose to 55 mbd in 2022-2023. I don't understand how the differences can be so great, and I trust Brown more than an energy institute (for example IEA and EIA have not won my trust, not the least). Brown is the one who have the most mathematical expertise in the field, of all involved. But I will calculate a scenario based on your data, anyway. I will link to that later on. I will also add that I have confronted many different sets of data in this field, all differing wildly, so I'm used to the confusion. But thank you for your answer, it gave me something to work on."

Dennis' answer to this comment of mine:

"Lars,

J Brown may be doing crude only estimates. Not sure."

My answer:

"Dennis, I think you're right (if you also add condensates), because the numbers of "Statistical Review of World Energy" are about 25 mbd higher than Brown's numbers, which is exactly the difference between "crude+condensate" and "All Liquids" in overall global oil production numbers (and now I don't mean oil exports). I actually figured it out before I read your comment.

I think, by the way, that Brown is justified in his way of counting only "crude+condensate" when calculating oil exports, because we cannot really count on the unconventionals in our

economy, if we seek sustainability, we cannot rely on them for a very long time to come, because they are so very expensive, and increasingly so, exponentially.

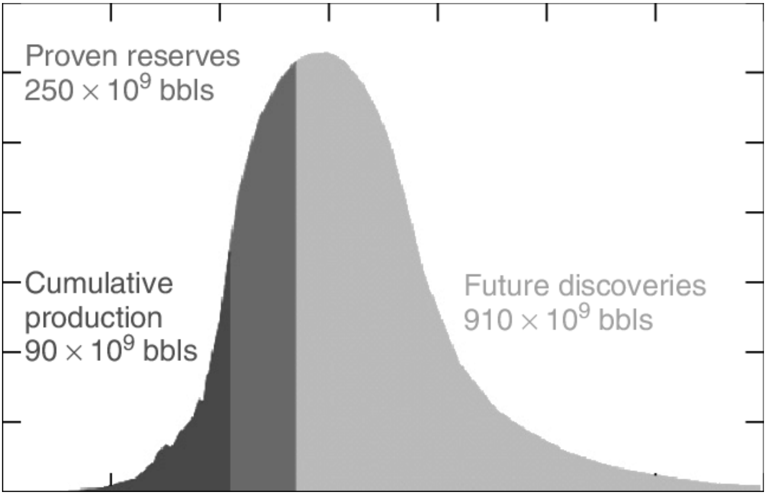
But your answer in some way confirmed my calculations, because I have indeed said in my book that Brown counted only crude+condensate, if I remember it correctly."

2) Now I will calculate the end of global net oil exports based upon the data of the "Statistical Review of World Energy" (a rewrite of this blogpost of mine):

"Preliminary data indicates that global liquids production in September was 0.1 Mb/d less than last month and averaged 100.6 Mb/d."

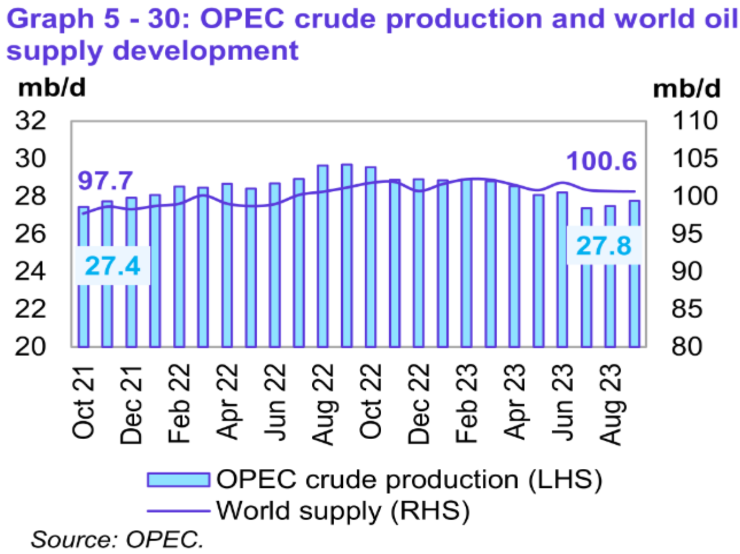
(Dennis Coyne in this recent blogpost on the blog "Peak Oil Barrel")

My comment: So global oil production fell by 100 000 barrels in one month, in August-September 2023. If this decline pace continues, it means 1,2 million barrels per day lost in one year, which is a decline rate of 1,2 % per year. Expect this decline rate to continue, and at last to begin to accelerate in the coming years, as the bell curve does in the "Hubbert curve":



(Graph from this website)

We probably reached the post-pandemic "All Liquids" oil peak in February 2023, at 101,5 mbd (1). See the following graph from Coyne's blogpost above:



If we take a very conservative, linear approach, and project a global oil production decline of 1,2% upon the future, fifteen, twenty years from now, then the decline of global net oil exports ("GNE") is at least the double of that (2), i.e. a 2,4 % yearly decline, which is 2,4 mbd lost per year (if we fix the amount of decline, because in percentage declines the amount of decline slows down with time, which it doesn't do in our case), which gives us almost **23 years of GNE** if we begin with 55 mbd of GNE, which brings us to the year 2046 (about the time when our conventional oil reserves are used up, according to systems ecologist Charles A.S. Hall's calculations, His end point was 2047). **Observe that I have not taken into account that the real decline of both global oil production and global net oil exports is exponential (it's a mathematical certainty, according to professional licensed oil geologist Jeffrey J. Brown), i.e. have an accelerated rate of decline, goes faster and faster (I use the term "exponential decline" to mean that in this blogpost). With that in mind, the end of GNE could very well happen well before 2046, which**

harmonizes with the thesis in [my book on the end of global net oil exports.](#) It could happen already in 2039-2042, which must be the **absolute upper limit in our calculations, for "All Liquids" exports**. So this is only 16-19 years into the future.

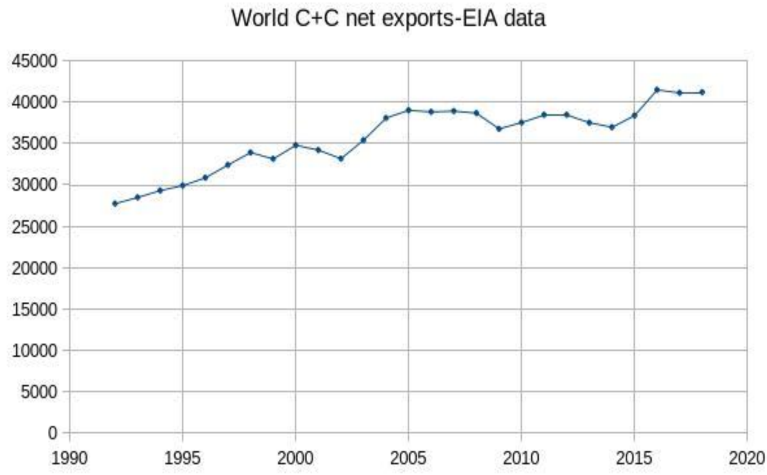
If we then go to the decline of **"ANE"** ("Available Net Exports"), which is "GNE" ("Global Net Exports", the totality of global net oil exports) less the Chindia (China and India) region's combined net oil imports, then the decline goes a lot faster, by at least 3 % per year, conservatively estimated. So 3 % of global oil production is ~3 mbd. We have 55 mbd of GNE left, at most. This give us only about 18 years of "ANE oil". And this brings us to **2041.**

Add then the exponential factor, and we are easily at **2034-2037**.

This, 2034-2037, is pretty much the best case scenario for the end of "All Liquids" global net oil exports, and is based on the results of "Statistical Review of World Energy's" global net oil export calculations.

3) Calculating with EIA's data

There are many data sets about global net oil exports out there. See how EIA calculates the global net **crude+condensate** oil exports from 1992-2018:

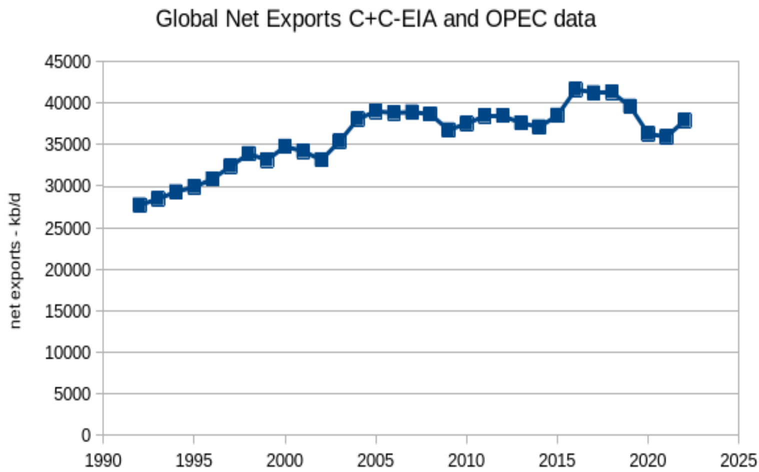


(Maybe EIA is double counting oil exports, as is hinted at in this comment by "Hickory"? This is very easily done)

So according to EIA we were at about 41 mbd of global net crude+condensate oil exports in 2018, not 35-36, which Brown would have it at, I think. How many years of "ANE oil" would that give us, if we calculate that we have about 41 mbd now, which is a conservative estimate? 41 mbd divided by 4 (see the footnote 2) mbd gives us about 10 years. It brings us to the beginning of the year **2034**. Remember that this is a linear scenario. Add then the exponential factor, and we are easily at 2027-2030, in about the area where Brown and I have ended up. This is strange, **that beginning with very much higher numbers, gives us so similar results.** Even beginning with the 55 mbd in the "All Liquids scenario" doesn't buy us many years, only a few, relative to Brown's and my scenarios. This should alarm everybody. How many years are three years actually? It's nothing in the grand scheme of things, and passes by very fast, at least for those who are 40 +.

4) Calculating with EIA+OPEC data

See how EIA and OPEC together calculates the global net **crude+condensate** oil exports from 1992-2022 or 2023:



According to this chart we reached peak global net oil exports, crude+condensate, in 2018, at 41-42 mbd, and then they have declined since about 2018. Now we are at 38 mbd, and the decline so far has averaged amost one mbd per year.

How many years of "ANE oil" would that give us, if we calculate that we have about 38 mbd now, which is a conservative estimate? 38 mbd divided by 4 (see the footnote 2) mbd gives us about 9,5 years. It brings us to the year **2033, almost exactly the year Jeffrey Brown predicted would be the end of "ANE oil".** And this is in a linear scenario. Add then the exponential factor, and we are easily at 2026-2029, in about the area where I have ended up in my book.

(1) *"World oil supply leapt 830 kb/d in February to 101.5 mb/d as the US and Canada rebounded strongly from winter storms and other outages."* (From the website "Oil Market Report - March 2023"). If we were at 100,6 in September this year, it's a decline of 0,9 mbd in 7 months, which translates to an average decline pace of ~1,54 mbd in a year, i.e. 1,54 %. This makes my calculations in this blogpost very conservative, because I calculate with a 1,2 % yearly decline, plus the fact that it is a linear decline, and that the decline amount is fixed. If we use the 1,54 % yearly decline, with a fixed amount of decline every year (otherwise the amount of decline would slightly decrease with time, which it does not do in our scenario), then the decline of global net oil exports ("GNE") is at at least 3,08 mbd per year in a linear scenario with a fixed amount, and the decline of "ANE" ("Available Net Exports", which is "GNE" less the China and India region's combined net oil imports) is at least 3,3-3,6 mbd per year in a similar scenario. How many years of "ANE oil" does this give us? Answer: **only 16,6 years** if we begin with 55 mbd of global net oil exports, and with 3,3 mbd of "ANE oil" lost every year, linearly. 16,6 years into the future brings us to **2040**. If we begin with 55 mbd of global net oil exports, and with 3,6 mbd of "ANE oil" lost every year, linearly, we get **only about 15,3 years**, which brings us to **2039**. **Observe that this is a linear approach, and that in reality the decline is exponential, i.e. an accelerated rate of decline (this is a thought experiment). I use the term "exponential decline" to mean that in this blogpost.** Add then the exponential factor, and we are easily at 2032-2034 as the end of "ANE oil", which pretty much confirms Jeffrey J. Brown's calculations. But observe that **Brown's calculations counted only "crude+condensate"**, i.e. conventional oil.

But observe also that the decline of global net oil exports is gradual, it does not just suddenly end abruptly. So when **do we have way too little oil exports in this scenario (so little that society collapses. This is what really matters here)**, especially too little diesel exports? It may happen already during the years 2027-2033, which makes the argument in **my book on the end of global net oil exports** relevant anyway, even if I was too radical in my calculations, relevant as a warning for a time of too little diesel exports, an appeal to ration the remaining diesel exports, adopting the precautionary principle.

(2) In this article on "The Energy Bulletin" from October 18, 2010, Jeffrey J. Brown and Dr. Samuel Foucher calculated the decline rate of oil production in the North Sea between 1999 to 2009 to be at 4.8%/year. During the same time oil exports from the area fell by more than double the percentage, yes almost a triple. Brown and Foucher says:

"Note that the net export decline rate exceeded the production decline rate, starting out in double digits, at 12.8%/year, and accelerated to close to 30%/year at the end of the net export decline period."

So my estimate that the decline rate of oil exports is at least 2,4 % right now, is conservative and minimalist, at solid ground, I think.

If we shall calculate the end of "ANE" global net oil exports with an almost tripling of the 1,2 % of overall global oil production decline, then we have to calculate with, say, an at least 3,2 % decline of "GNE oil", and about a 4 % decline of "ANE oil" *. 4 % of global oil production is about 4 mbd (which, subtracted yearly from our amount of oil exports, translates to a loss of as much as **333 000 mbd "ANE oil" every month**). How many years will a yearly decline of 4 mbd "ANE oil" give

us? 55 divided by 4 gives us about 13,75 years. 13,75 years from now we are in **2038**. Add then the exponential factor, and we are easily in the years 2032-2034.
If we then account for the almost one million barrel that has been lost in overall global oil production since February 2023, and which is not accounted for in Statistical Review of World Energy's graph above, then we have to subtract almost the quadruple amount from oil exports (because "ANE oil" declines with almost the quadruple rate of overall global oil production, compare the 1,2 % with the 4 % above), which is about at least 3,4 mbd. So 55 mbd minus 3,4 mbd is about 51,6 mbd. How many years will a yearly decline of 4 mbd "ANE oil" give us if we start with 51,6 mbd? Answer: 12,9 years. This brings us to the end of the year **2036**. Add then the exponential factor, and we are easily in the 2030-2033 range, which confirms Jeffrey J. Brown's calculations. **But Brown calculated oil exports with only "crude+condensate", and here we are calculating the "All Liquids" oil exports.** So the end of "All Liquids" oil exports could be in the 2030-2033 range, while the end of conventional, "crude+condensate" oil exports, could very well be around 2027, plus or minus a few years, which was what I predicted in my book. So, again, my numerous calculations in my book are confirmed.

* I have in my book on oil exports calculated that the end of "ANE oil" comes about two years before the end of "GNE oil" (it has a much steeper decline curve). If our time window is ten years, then two years of that is 20 %. 4 mbd is almost 20 % more than 3,2 mbd (4 mbd is 0,8 mbd more than 3,2 mbd. 5 x 0,8 is 4. 20 % of 4 is 0,8).

For confirmation, see this article from 2012 by Jeffrey J. Brown, where he says:

"Our database shows that GNE fell from about 46 mbpd (million barrels per day) in 2005 to about 44 mbpd in 2011."
"We define available net exports (or ANE) as GNE less China and India's combined net oil imports. ANE fell from 40 mbpd in 2005 to 35 mbpd in 2011 as the developing countries, led by China and India, consumed an increasing share of a declining volume of GNE."

So already from the beginning, ANE fell by a whopping 5 mbd in six years, while GNE fell with only 2 mbd in six years. A decline of 5 is more than double the decline rate of 2.

2 mbd in six years is a decline of 4,3 % of the original 46 mbd of GNE, and is a yearly decline of 0,33 mbd per year or a 1,43 % yearly decline.

5 mbd in six years is a decline of 12,5 % of the original 40 mbd of ANE, and is a yearly decline of 1,2 mbd per year or a 3 % yearly decline.

As you can see, 3 % is more than 2 times as much as 1,43 %. So much faster the ANE declined in comparison with GNE, in the beginning, according to Jeffrey J. Brown's calculations.

4 mbd is not the double of 3,2 mbd, only 20 % more (see above). So my calculations are very conservative, leaving room for hope. If we would calculate that the end of "ANE oil" is 80 % sooner than what has been assumed of the end of "GNE oil", where would we land? 80 % of 2 years is 1,6. So the end of "ANE oil" would then come, not two years earlier than the end of "GNE oil", but at least three and a half year earlier, which would make the results of my calculations even more radical. The decline percentage of "ANE oil" would then be 2 X 3,2 %, which is 6,4 %, which, if I applied it on my calculations, would make the end of "ANE oil" come even sooner. Therefore my calculations here are conservative, but I stick with that, so I'm able to believe in my own calculations. Maybe Brown made some mistakes here, because it seems too radical. Just think

about it, if we have 30 mbd of global net oil exports, crude+condensate, today **, then how many years of "ANE oil" do we have if the decline is by 6,4 % every year? With a linear approach, not even counting on an accelerated decline? Answer: **only 4,6 years,** in a linear scenario, which brings us to the year 2028. And with an exponential approach, we then arrive in 2024-2025. This reminds me of my calculations in my book on oil exports, and makes me understand why I arrived at so radical conclusions in it.

* * We were at 97,7 mbd "All Liquids" oil production in October 2021, when Jeffrey J. Brown made his statement about us having 30 mbd of global crude+condensate net oil export left. This makes it tricky. We had our post-pandemic peak in February 2023 at 101,5. This is 3,8 mbd more than in October 2021. It translates to about at most 3-4 mbd of global net oil export gains, in crude+condensate, because at the same time oil exports followed the decline trend from 2005, and declined even more, this was the underlying reality. So we maybe gained at least 6 mbd of "GNE oil", but lost at least 3 mbd to the natural decline. So, if we were at 30 mbd of "GNE oil" in October 2021, we were probably at mostly 33-34 mbd of "GNE oil" in February 2023. Since then overall oil production (All Liquids) has declined by 0,9 mbd, which translates to about 3-4 mbd less oil exports (because the pace of decline of "ANE oil" is almost quadruple the decline of overall global oil production, see what I have said about it above), so we land at about 30 mbd "GNE oil" today. This is difficult to calculate, so the reality may be more than or lesser than this amount.

Response to more critique of my work on oil exports

Published 2023-10-29 on my blog ”I väntan på Jesus”

(this blogpost can very well be read to the music of ***this very beautiful song*** *by Björk. The end is especially beautiful)*

In this comment on the blog "Peak Oil Barrel", RESERVEGROWTHRULZ gave the following critique of my work on oil exports:

"RESERVEGROWTHRULZ

To Lars:

Jeff Brown used his own ELM to declare a major export oil crisis like in 2006 or so. Have you corrected for why his system was structurally wrong in the first place?"

My answer:

RESERVEGROWTHRULZ, it is not true that Brown predicted a major export oil crisis to begin in 2006. He said back then that the end of global net oil exports would come in the thirties, more exactly 2030-2032, depending on which articles by him you read.

Remember that Brown's calculations was about conventional oil exports, or "crude+condensate" exports (I'm not so sure what the difference is between these two). Global conventional oil production has been on an undulating plateau since 2005 (see the charts in this blogpost). This is common knowledge among the more pessimistic peakoilers.

But even if we calculate with "All Liquids" data, instead of conventional oil/crude+condensate data, the results do not differ much, perhaps only by a few years (see section 2 in this blogpost). When I calculated the end of global net "All Liquids" oil exports, beginning with 55 mbd (EIA data), I landed on 2030-2033, whereas when I began with the 30 mbd for 2021 (Jeffrey Brown's data), I landed at around 2027. So the difference was only 3-6 years, which is a very small one in the grand scheme of things. This should alarm policy makers deeply. It is the rate of decline, not the amount we begin with, that is the really important thing here.

Peakoilers like Kurt Cobb and Art Berman have talked about a "stealth peak oil", because one has begun to count all sorts of strange unconventional and very expensive "oils" as "oil", making it seem like everything is fine and global oil production is growing, just like before. But the situation isn't the same any more. Something big has changed. Just watch oil geologist Art Berman's videos (the interviews with him), and you will understand.

The same can be said about oil exports. There is a "stealth peak oil exports" and a "stealth decline of oil exports", because of corrupt and meaningless oil news reporting and false, deceiving calculations, hiding the reality, just like the US government is so good at doing in other fields of the economy, with things like the inflation numbers and the like. **Conventional oil exports**, which is what really matters here, which is what one can build a high-tech civilization with (this cannot be said of many unconventional oils, so low EROEI they have, neither of "renewables"), the oil where most of the diesel lies (diesel is the most important oil product in the world, it's what make trucks running, the hemoglobine of civilization), **peaked in 2005**, when conventional oil peaked (which is pretty logical, I cannot understand how EIA can have it peaking in 2016, see the charts in this blogpost), at 45-46

mbd. This is reasonable, because still in 2012 there was about 30 oil exporting countries. Today there is even fewer such, and as much as about 97 oil producing countries, if the data in that Wikipedia-article is not very old. Remember that according to Brown we have about 30 mbd of conventional oil export today, out of about 80 mbd of crude+condensate oil.

If conventional oil and conventional oil exports peaked in 2005, **it has to have declined ever since**. It is a **mathematical certainty**. Why? Well, oil exports always decline much faster than overall oil production declines, and it declines even when oil production is flat. It is because not only the oil importing countries, but also the oil exporting countries grow their own oil consumption, usually exponentially. If they do it exponentially, then the decline of oil exports **has to be** exponential, i.e. at an accelerated rate of decline (I use the term "exponential decline" thus here). Let's see what the growth rates of the world economy is, on average. This article says: **"Between the years 1900 and 2000 world GDP at constant prices has increased about 19-fold, corresponding to an average annual rate of growth of 3 percent."**

This growth pace has continued since the year 2000, just look at this article and this article. I would say that since 2005 the average growth of GDP has been between 3 and 4 %.

What about the growth since 2005, not of conventional oil production, but of "All Liquids" production? Has it followed that pace?

No. Not at all. The rise in "All Liquids" since 2005 has been at most 18 mbd (see the charts in this blogpost). I.e. it has risen 21,4 % in 18 years, which is on average a rise of 1,19 % per year. Compare this to the average 3-4 % of world GDP growth since 2005.

There is not a direct symmetry beween the amount of GDP growth and the amount of oil production/consumption growth. They are not equal. Because GDP does not actually measure how big the real economy of materials and tangible things is, or how much energy it consumes (although "energy is the economy"), but it only measures the amount of transactions that take place in it. I think that if the economy grows at 3 % per year, the actual economy of tangible things (not just the financial economy of speculative bubbles and the movements of money) and tangible energy consumption maybe grows at half that pace, at 1,5 % per year. I remember reading something like that (I'm not sure, but I can't find where I read it) on ecological economist Dr. Tim Morgan's blog writings (see these charts by him), and it makes sense to me.

So we can say that if oil consumption ("All Liquids") has grown globally with 1,5 - 2 % per year since 2005 (this is half of the 3-4 %), and global oil production has grown only with 1,19 % per year, then it is a **mathematical certainty** that "All Liquids" exports has had to decline since 2005, and this with an accelerated rate. This make me distrusting oil export data from energy institutes like "Statistical Review of World Energy", EIA and OPEC, and makes me give credit to professional, licensed oil geologist Jeffrey J. Brown, the most educated oil export mathematician out there, who have understood these things, and made a lot of calculations based upon them. The more I calculate, the more my calculations line up with his, albeit I often come to even more radical conclusions.

And then to the question if there has been an oil export crisis. Sure it has! Where else does the slowdown of the world economy come from, if not from the decline of oil production or oil exports? Some parts of the world economy are even downright collapsing, in slow-motion (even the center of it, the

US, has for a long time been in the process of beginning to slowly collapse)! Are you unaware of this fact, RESERVEGROWTHRULZ? We would have needed at least one new Saudi Arabia in oil to avoid this, since 2005, and it has not materialized. In fact, **we got a new Saudi Arabia**, in oil, and that was the shale oil boom, albeit very expensive oil, not like Saudi oil. The problem was only that we had needed **two Saudi Arabias, one of them cheap to produce, to avoid a debt crisis**. In the future we will need even more of those things, because of the high natural decline in our existing oil fields.

But there are powers who profit from us being unaware of the "stealth collapse", so we stay obedient consumers, putting our hopes in the infinite growth paradigm, which only the rich part of the world can afford to hope for and practice. The others try to "save and survive", and become more and more collapse aware for every passing year. **I can almost see** the blinders on the people of the rich world. And the blinders are made of dollar bills, the silly logic of money and consumerism.

A correction to a mistake in my book "The end of global net oil exports"

Published 2024-03-08 on my blog ”I väntan på Jesus”

(this blogpost can very well be read to the beautiful sound of Björk's song "Unison", which is most beautiful in the end, the end is very melancholic and bittersweet)

I have discovered a mistake in this book. This is the most important mistake I have found (I haven't found any other mistakes lately):

It is that I forgot that the 30 mbd of conventional global net oil exports that oil geologist Jeffrey J. Brown thought we had in the end of 2021 (October 14, 2021), was during the middle of the pandemic, when global oil production had fallen by 10 % during the spring 2020, and that the global oil production has risen since then substantially. Maybe with 2, mostly 3 mbd, since the end of 2021, if we only count conventional crude oil, minus condensate (see this graph for confirmation, but this shows "All Liquids"). This has to be accounted for in my calculations, which I didn't do. I think then that we have, at most, 29 mbd of global net oil exports left this year (I thought it was 30 mbd in the end of last year, so this is a conservative guess, we lose so much oil exports every year nowadays). I come to this conclusion by accounting for those 2-3 mbd in oil production growth, over 2,4 years (since October 2021). And if one calculates that we have also lost a lot of global oil exports, to the natural decline, since the end of 2021, the sum of it is that we still have mostly 29 mbd of oil exports today (overall conventional crude minus condensate has declined somewhat since the post-pandemic peak). This is just an educated guess.

At most 2,4 years of oil exports has to be added to my calculations (since the end of 2021). And we have here a decline of oil exports spanning over 22 years, beginning in 2005 and ending in 2027, which is the end point in my best calculations, my best guess about when we lose our last conventional global net oil exports. How big part is 2,4 of 22? Answer: about 10 %. So we have to add 10 % to our results. So if our average year for the end of global net oil exports is 2025, then 10 % more (of 22 years) is 2,2 years, which is also a good number for what we gained in the post-pandemic peak of oil production and oil exports, during the time October 2021- March 2024.

If we add 2,2 years to the average year for the end of global oil exports, 2025, **then we come to the beginning of 2027, exactly the year that was the result of my best calculations in my book above.**

So again I find my thesis in my book confirmed.

I should also have added to my book that oil exports behave like conventional oil production, that when we lose conventional oil exports, we also lose unconventionals. We will never be able to export only unconventionals, so expensive these are. I wrote something about this phenomenon, pertaining to conventional oil, in this recent blogpost.

2034 is the uppermost possible limit for the end of conventional global net oil exports, minus condensate

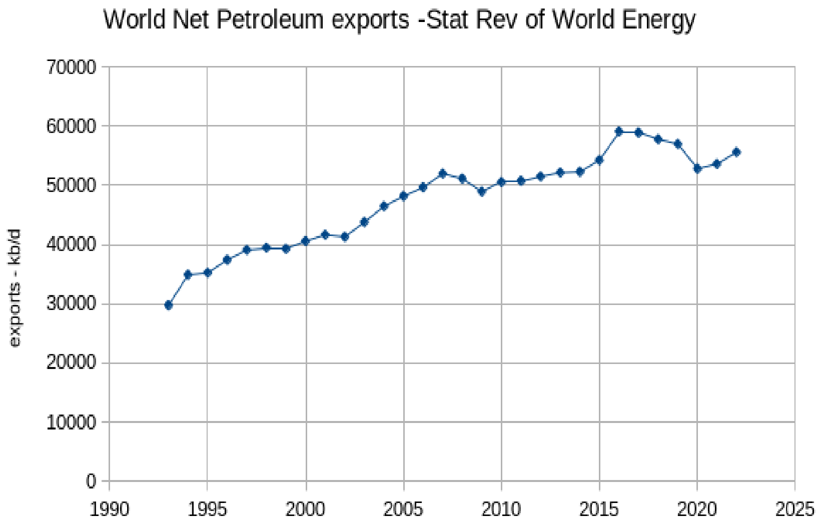
Published 2024-03-09 on my blog “I väntan på Jesus”

(this blogpost can very well be read to the beautiful "Lullaby" by "The Cure")

In an interview 2021 (1), peak oil author and blogger Alice Friedemann said that 2035 we have only half as much global oil production, All Liquids, as when we peaked in November 2018. I think this is realistic, albeit it feels pessimistic.

That takes us to about 51 mbd in 2035, because the world peaked in 2018 at 102,4 mbd, All Liquids.

If we, as I assumed in this recent blogpost, lose our last conventional global net oil exports in 2037, then we have two years more of overall oil decline (from 2035), and if we, as I assume, lose **at least** about 3 mbd every year of overall oil production (All Liquids), at that point, then we are at 46 mbd of overall oil production (All Liquids) in the beginning of 2037. That makes room for losing the 55 mbd of oil exports, All Liquids, that I have encountered in the most optimistic charts I have found, for example this graph:



(I found the chart here)

If we then count only conventional crude oil exports, minus condensate, then the end comes way before 2037, and it's actually the conventionals that really counts, it's where the diesel lies, diesel, the motor of civilization, of all transportation.

Secondly, we have only 29 mbd of conventional global net oil exports to lose, between 2024 and the end of the conventional oil exports, if we count from now on, based on Jeffrey J. Brown's calculations. Then the conventional global oil production, minus condensate, which is now at 68 mbd, needs to be at 34 mbd in order to be at the half point between now and the end of it. Let's think that this 34 mbd of conventional crude only (minus condensate) happens in 2035, when All Liquids are at their half point (this is an optimistic estimate, because conventionals only, decline faster than All Liquids). Then the end of global conventional crude net exports (minus condensate) **has to come before 2035**, because we have 29 mbd to lose, not 34 mbd. We might lose the last drops of those 29 mbd

already in 2034, because so late in the game we lose at least 5 mbd every year of conventional oil exports. So this make 2034 the uppermost possible limit for the end of conventional oil exports (minus condensate), if Alice Friedemanns predictions would get vindicated by the future.

(1) From Derrick Jensen's interview with Alice Friedemann (she is the one operating the blog "Energy Skeptic") one year ago, titled "Alice Friedemann—Life After Fossil Fuels book—Derrick Jensen Resistance Radio 2021-09-05".

Calculating the end of global net oil exports, "All Liquids"

Published 2024-03-13

(This blogpost can very well be read to the sound of the beautiful song "Yellow" by Coldplay. This is my love greeting to all my readers. Remember that we are soon entering "The Millennial Kingdom", my friends! See you all there!! My frequent blogposts about the end of oil is a witness to this fact. The decline of oil is an even more certain field of knowledge in order to know the timing of the end of the world, than the science of global warming/heating)

According to the footnote * (a comment to footnote 2) below this blogpost of mine from 27.10.2023, the decline rate of global net oil exports, All Liquids, will be 6,4 % on average, right now, or pretty soon, for "ANE" oil ("Available Global Net Exports", which is "GNE" ["Overall Global Net Oil Exports") less the China and India region's combined net oil imports).

6,4 % of 52 mbd (the amount of All Liquids exports I estimate that we had in the end of 2023, because the exports have a tendency to decline fast when overall oil production is flat and the world economy is growing fast, which will be the case this year, and which also was the case last year, yes even more so) is 3,3 mbd. This is where we should begin. How many years does an annual decline of 3,3 mbd give us, in a linear scenario? Answer: **15,7 years.** This takes us to the end of the year 2038. But remember, this is a linear scenario. Then we could say: 2038 is the uppermost possible limit for the end of global oil exports, All Liquids.

But let's calculate what an exponential, accelerated decline rate (because this is the way the end of oil exports behave) gives us for a result. We begin with a conservatively estimated decline of 3 mbd annually for 2023, and end with **a whopping 19 mbd** of annual decline (such is the exponential factor! It's unbelievable in the end). Then it ends in the middle of the year 2030, which pretty much confirms my previous calculations in this book, where I only focused on conventional crude (minus condensate) only, and diesel exports.

But let's make a simple model of the decline of All Liquids oil exports:

2023: We start with 55 mbd, in the end of the year we had 52 mbd.

2024: 52 - 3 mbd = 49 mbd (this means that in the end of the year, we have 49 mbd)

2025: 49 - 3,5 mbd = 45,5 mbd

2026: 45,5 - 5,3 mbd = 40,2 mbd

2027: 40,2 - 7,3 mbd = 32,9 mbd

2028: 32,9 - 10 mbd = 22.9 mbd

2029: 22,9 - 13,5 mbd = 9,4 mbd

2030: 9,4 - 19 mbd = 0

Let's then make a simple model of how much All Liquids oil exports (of "ANE" oil) we have annually if the end of it comes in 2032, which is Jeffrey Browns date. This also requires a whopping 19 mbd annual loss in the end:

2023: We start with 55 mbd, in the end of the year we had 52 mbd.

2024: 52 - 3 mbd = 49 mbd

2025: 49 - 3,2 mbd = 45,8 mbd

2026: 45,8 - 3,6 mbd = 42,2 mbd

2027: 42,2 - 4,1 mbd = 38,1 mbd

2028: 38,1 - 5,1 mbd = 33 mbd

2029: 33 - 7 mbd = 26 mbd

2030: 26 - 10 mbd = 16 mbd

2031: 16 - 14 mbd = 2 mbd

2032: 2 - 19 mbd = 0

In this article on "The Energy Bulletin" from October 18, 2010, Jeffrey J. Brown and Dr. Samuel Foucher calculated the decline rate of oil production in the North Sea between 1999 to 2009 to be at 4.8%/year. During the same time oil exports from the area fell by more than double the percentage, yes almost a triple. Brown and Foucher says:

"Note that the net export decline rate exceeded the production decline rate, starting out in double digits, at 12.8%/year, and accelerated to close to 30%/year at the end of the net export decline period."

What is 30 % of 59 mbd (the peak of global All Liquids exports, which happened in 2016 according to Statistical Review of World Energy. The North Sea oil peaked in 1999, see this

article)? Answer: 17,7 mbd, not far from our 19 mbd decline pace in the last year of our modelled end of All Liquids exports, an annual pace that never reaches the end of the export barrels in our model. Probably global All Liquids oil exports decline will reach those higher levels in their end phase, especially because of the ongoing collapse of industrial civilization, which makes the end of oil production **very steep indeed**, which is accounted for in my 19 mbd of oil exports decline. The end of the North Sea oil exports never saw a collapsed UK, just for comparison. Now the UK is collapsing, though. But, as I have pointed out before, the right thing to do is to follow the decline of conventional crude (minus condensate) oil exports, because we will never have only unconventionals without conventionals to export, because the former are so incredibly expensive, and exponentially more so as time passes by, the former being subsidized by the latter. And what is most important: **It is in the latter, in the conventionals (minus condensate) where most of the diesel lies**, diesel being the most important motor of our global civilization. Not even condensates make any substantial diesel, which is witnessed in this comment by an oil expert. He says "*refineries get very little diesel fuel from condensate*".

Shale oil, or "tight oil", belongs to the same category as condensates when it comes to its usefulness for diesel (other liquids in the same category are NGL [Natural Gas Liquids], biofuels and refinery gains). Shale oil from America is called "super light oil". This article from 2018 says the following about American shale oil, which creates problems for American refineries, focused as they are on heavier oil, oil that one can make diesel of:

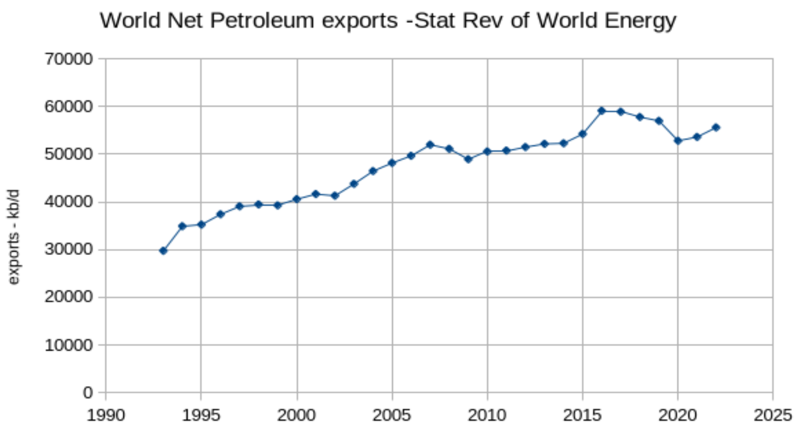
"Making matters worse, Morgan Stanley expects so-called middle distillates like diesel and jet fuel to account for most of the growth in oil demand, and light crudes aren't ideal for making these products."

This article by Whitney Sheng from 2020 also says the same: "Too much oil, too little diesel".

Diesel shortages, which in the US was such a hot issue in the end of 2022 (I remember it on youtube), **has not gone away.** See for example the following article from only half a year ago, September 17, 2023: "The World Is Struggling to Make Enough Diesel".

Diesel is really the **fateful object** in the end of oil exports and overall oil production. Therefore Jeffrey J. Brown did the right thing indeed, focusing on conventional crude oil minus condensate, where most of the diesel lies.

[1] Here is the graph (from this comment on the blog "Peak Oil Barrel") that I build my calculations upon, except for the most recent data:



Modelling the accelerated decline of global conventional crude oil (minus condensate) production, with data from Steve St. Angelo

Published 2024-03-19

(This blogpost can very well be read to the sound of the beautiful song "Silence must be heard" by Enigma)

In this recent Youtube chat video that Ukrainian-Canadian hippie and peakoiler Andrii Zvorygin had with Steve St. Angelo (from the blog "SrsRocco Report", one of the most educated peakoilers out there) and some others, 36 minutes into the video, I found some very important and seldom mentioned data (which is almost impossible to find on the internet, so bad is the education level there [1], although this is about the most important data we can get) by Steve St. Angelo about the decline of global conventional crude oil (minus condensate) since 2006. Here are the most important data:

In **2006**, at the peak of it, we had 70,3 mbd of conventional crude oil (minus condensate) production.

In **2016**, we had 69,6 mbd.

In **2019** we had 66,5 mbd.

In **2022** we had 63,5 mbd.

Let's calculate the decline between 2006-2022 (in the end of this year, 2022, oil production had pretty much recovered from the sharp decline during the peak of the pandemic, from 88 mbd in May 2020, up to 101,6 mbd in November 2022, see the chart in [2] and [3]):

I divide the period 2006-2022 into two periods of 8 years (this, periods of 8 years, was also essential to my book 2023 about global oil exports). In 2014, at half the time into this age, the level of conventional crude oil minus condensate was at about the same level as in 2016, at 69,6 mbd.

1) **2006-2014**: From 70,3-69,6. A decline of 0,7 mbd, or 1 % for the whole period, on average ~0,09 mbd per year, which is 90 000 mbd per year.

2) **2014-2022:** From 69,6-63,5. A decline of 6,1 mbd, or ~8,7 % for the whole period, on average 0,76 mbd per year. **So in 2022 we lost at least 760 000 barrels of conventional crude minus condensate in only one year!! Probably as much as 1 mbd!! So fast the decline goes nowadays! And it is even worse now!!!**

Then to the future projection. 8,7 is 8,7 times 1. So in the second period above, the oil decline was 8,7 times faster than in the first period. So this means that in the third period,

3) **2022-2030**, the decline, if it follows the trend, will accelerate 8,7 times the decline in 2). Remember that we are late in the decline period 2006-2030, and when something declines exponentially, i.e. with an accelerated rate, which global conventional crude oil (minus condensate) does right now, the decline is really, really fast in the end, and catches one with surprise (I have to concede that I have trouble believing in my own calculations in this blogpost). Remember that in the previous periods, civilization was not in collapse (and anyway the decline soon got steep)**, which it is now and will continue to be in the 3) period, which makes the decline very, very steep.** If the decline could accelerate 8,7 times between 2006 and 2022, **what then when civilization and the oil industry goes into its collapse phase, which accelerates exponentially, i.e. at an accelerated rate of decline?**

8,7 X 6,1 mbd is ~53 mbd. 63,5-53 mbd is 10,5 mbd. So in 2030 we have 10,5 mbd of global conventional crude oil minus condensate left. 53 mbd in 8 years, it's on average a ~6,6 mbd annual decline. In the end of the 2022-2030 period the decline rate is above 10 mbd a year, which is the natural decline rate of the global oil production today, according to Steve St. Angelo (more exactly 10,5 %). And in that year 2030 the decline goes so fast that we lose all the remaining oil reserves in one year, so it all ends in 2031.

If the global conventional crude oil minus condensate production reaches its terminal end in 2031, **one could assume that global conventional crude oil minus condensate <u>exports</u> reaches its end <u>way</u> before that, perhaps in 2027, at the earliest.** Because the decline rate of global oil exports is much higher than that of overall global conventional oil (minus condensate) production, and falls at an accelerated rate of decline. **This again confirms my calculations in my book about global oil exports.**

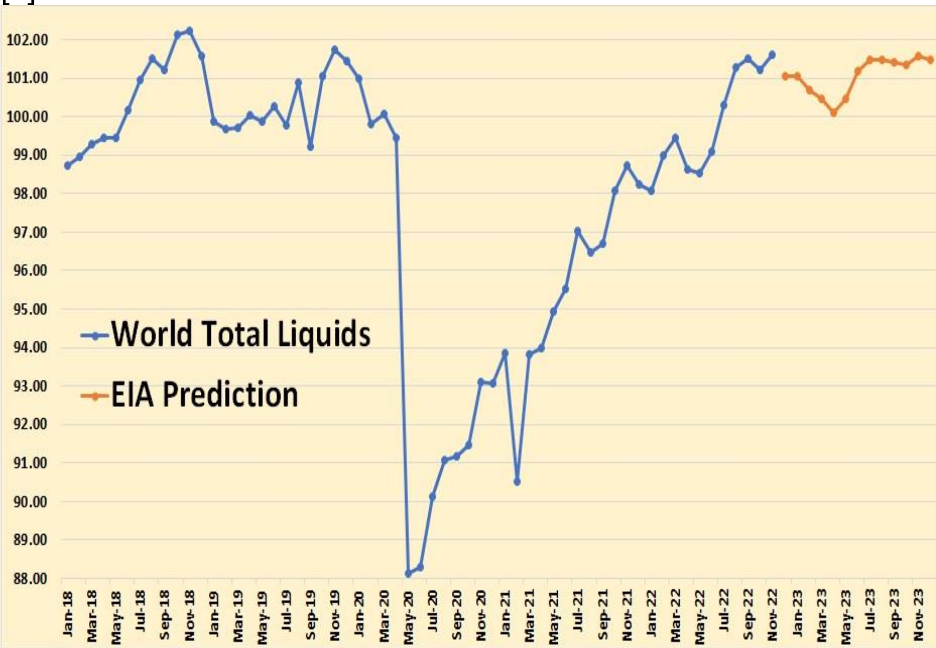
P.S.: Andrii Zvorygin has a very remarkable graph (which I think he has made together with John Peach) in the video chat above, 1.14.04 into the video, about the remaining oil reserves, where he shows that **we have only 5-16 years of conventional oil reserves left (2PCS).** 8,55 years of 1P (proven) reserves, and 8,41 years of 2P (probable) reserves.

This 5 year figure is the most radical I have heard of, and it really makes me lyrical and hopeful.

[1] Try to do a research on images for charts on the global conventional crude oil minus condensate, and you will find tons of

meaningless, totally irrelevant and **stupid** information, most of it very, very outdated. Information that seldom in any way help us to prepare for the END. So bad the search engines are, still. And so stupid the peak oil community was and is. You don't, for example, find very much useful information on the end of global oil exports.

[2]



[3]

Graph 5 - 29: OPEC crude production and world oil supply development

